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JOINT BULLETIN

OF THE

STATE DEPARTMENT OF EDUCATION

AUSTIN, TEXAS

UNIVERSITY OF TEXAS

AUSTIN, TEXAS

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

COLLEGE STATION, TEXAS

JOINT BULLETIN NO. 1

OCTOBER 1, 1914

Courses In Agriculture for the Secondary Schools of Texas

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W. F. DOUGHTY

State Superintendent of Public Instruction, Austin, Texas

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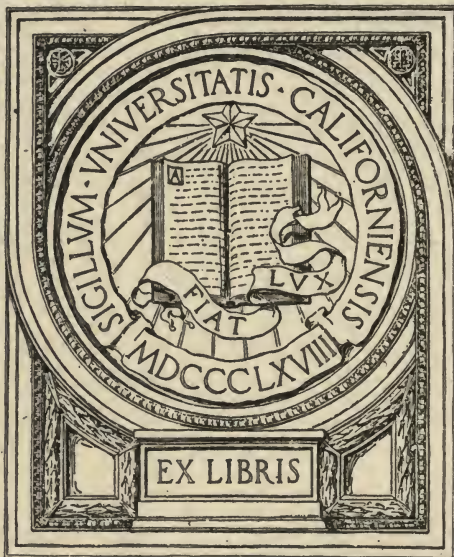


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PREFACE.

There are at least three agencies in the State that are putting forth organized efforts, in the form of supervision and inspection, for the improvement of the high school conditions in Texas. The State Department of Education, the University of Texas, and the Agricultural and Mechanical College of Texas are endeavoring to give personal help to the high schools of the State, assisting superintendents and teachers to make their schools more efficient in subject matter, methods, equipment, etc. The friends of education have always felt that there should be the most hearty coöperation among those agencies in this great work.

The traditional courses in the high school have been subjects of investigation so long and have been so standardized that there will seldom be serious conflict of ideas among students of education concerning the content of the courses, the arrangement of subject matter, the methods of presentation, etc. It is not so with agriculture. The courses in this subject have not passed the experimental stage. Few suitable textbooks are available when the work in agriculture exceeds a general course consisting of one unit of work. Careful planning of the work to be done is necessary, and definite directions for finding the subject matter in the available publications are needed. Students of agricultural education vary widely in their views of the choice and arrangement of the subject matter, as is seen in a perusal of the various courses in agriculture proposed for high schools in different parts of the United States. The authors of this bulletin have agreed upon the recommendations and suggestions in the following pages and present them to the high schools of the State as a basis for work in agriculture that will meet the approval of the State Department of Education, of the University of Texas, and of the Agricultural and Mechanical College of Texas.

This bulletin is intended for the teachers of agriculture in the high schools and for all others interested in secondary agricultural education. A copy of it can be secured from any of the agencies participating in the joint publication.



COURSES IN AGRICULTURE FOR THE SECONDARY SCHOOLS OF TEXAS

INTRODUCTION.

FUNCTIONS OF THE HIGH SCHOOL.

"All schools are in their nature public utilities." It is the one fundamental purpose of the high school to give that training which will prepare the student for greater efficiency, greater usefulness, and a larger service. All boys and girls leaving the high school should go with a definite purpose in life, and should be able to turn back to the public the money expended on them in increased efficiency. If they are not able to do this, the school is a parasite from an economic point of view. It is also the function of the high school to give the student such amount of cultural training as will help him appreciate the beautiful in nature and in art, and at the same time to enable him to choose a vocation for life. In other words, our secondary schools should strive to give a liberal education—an education that is both cultural and vocational, and discipline will be a product of the vocational as well as of the cultural if the work is well done. In this way the high school will not only be able to give graduates a better preparation for life, but will inspire them to continue their training.

REASONS FOR AGRICULTURE IN THE HIGH SCHOOL.

For more than a decade our magazines and other publications have been full of discussions of agriculture and its importance in the high school curriculum. At one time it was necessary to present numerous carefully selected arguments to justify the introduction of agriculture. Now it is seldom needed to give justification for introducing the subject, but it is more often necessary to offer excuse for the failure to provide an opportunity for high school pupils to receive instruction in agriculture and other vocational subjects.

The arguments that have been advanced from time to time are numerous and varied. Space will not permit here a discussion of the individual arguments offered. In general these reasons can be classified under one of two heads: (1) arguments advanced by agriculturists, based on a knowledge of the subject from a vocational viewpoint; (2) arguments advanced by educators, based on the psychological importance of the subject. Some of the more important points may be summarized as follows:

Arguments advanced by agriculturists:

1. Increased production is needed.
2. Conservation of soil and of other resources is necessary.

3. The subject is important because of the size and importance of the industry.
4. Competition with European farmers demands agricultural education of people.
5. The field is too broad for an agricultural college to cover.

Arguments advanced by educators:

1. Agriculture enriches the curriculum and adds interest.
2. It helps keep students in school.
3. It involves expression as well as impression; it gives ability to do.
4. It gives motive for science study—first the application and then the science.
5. It is cultural, broadening.
6. It gives a comprehensive view of science.
7. It has value as an avocation.
8. It has value for vocational guidance.
9. It gives understanding and appreciation of rural environment, etc.

PRESENT STATUS.

Agriculture in the high schools of Texas is just in its infancy. A beginning has been made, and in a very few schools some rather extensive work has been done. In a large majority of the schools the work has been too bookish. Too little time is given to the subject to enable efficient practice work. Much of the psychological value of the subject is lost when the laboratory and field work are slighted. In most cases the pure agriculture is limited to one year in the high school. A few schools are offering a second year, one school has been found with three full years of work in operation, and one school with four years of work. Some schools are counting as agriculture the traditional courses in botany, physical geography, zoology, physics and chemistry. These, as ordinarily taught in the high school, with the exception of botany, would hardly be considered agriculture, though they might well be included in the course of study for the agricultural pupils.

The State has made a good beginning in aiding the high schools to provide for the introduction of agriculture. But the appropriations have been much too small to supply the demands. During the two years, 1911-12, 1912-13, fifty-nine high schools teaching agriculture received from the State \$117,800. In 1913-1914, thirty-two high schools received \$25,750. This aid in many instances was intended for manual training and domestic science also. Of the fifty-nine schools included above, 27 maintained an agricultural department alone; 23 maintained the three departments; and the remaining 9 maintained agriculture and one other.

Of these 32 schools aided in 1913-1914, ten are maintaining agriculture alone; 13 are maintaining the three departments; and the remaining 9 are maintaining agriculture and one other department.

The above data do not include state aid given to those schools not offering agriculture.

For this entire period of three years, 1911 to 1914, the total aid from the State given to a single school offering agriculture varies from \$500 to \$5,750. The number of schools that have received \$5,000 or over is 11. The number having received \$2,000 or more is 28. The largest state aid given any school during 1913-14 was \$1,250.

In giving State aid, no specifications have been made as to what proportion of that aid shall be used for each of the two or three departments participating. Unfortunately, the idea has prevailed that agriculture can be taught with little or no equipment save a plot of ground. So manual training and domestic science departments have been equipped at the expense of the agriculture department. There are, however, at least a few notable exceptions where every dollar of the State's money and more is invested in valuable and permanent equipment for agriculture.

According to the records in the office of the State Superintendent there are 75 high schools in the State maintaining an agricultural department. This means that many communities have not yet appreciated the value of this subject in the curriculum and in the lives of the young people of Texas. It is very desirable for the State to help equip the schools for agriculture, but the local communities cannot afford to omit the subject because state aid is not available. If the fifty-cent levy will not enable the district to finance the department, then votes in the district should not be lacking for a constitutional amendment to raise the limit of taxation.

GENERAL REMARKS TO SCHOOL OFFICERS.

TEACHER.

A matter of great importance for school officers who are introducing agriculture into the high school is the selection of a teacher. With an ideal teacher in charge, many deficiencies of equipment may be overbalanced in a measure, while the best and most extensive equipment may be of little or no consequence if the teacher is inferior. It is worth while to enumerate some of the qualifications a teacher of agriculture in the high school should possess.

In the first place, the teacher of agriculture should have a larger amount of technical information about the subject to be taught than is demanded in many other departments before he can teach the subject acceptably. The various phases of agriculture are so interwoven and so interdependent, and the underlying sciences are so extensive and so important to a proper understanding of the principles and practice of agriculture, that careful and extensive training in scientific and practical agriculture is necessary to insure success from the teacher in the agricultural department of the high school. Usually it is assumed that a teacher's training in his subject should be from two to four years in advance of the work to be done in the class. If this is necessary in teaching history, mathematics, etc., it is still more desirable in the teaching of agriculture. However, in the four-year course here outlined for high schools, even the graduates of agricultural colleges will be required to teach near the limit of their training in some parts of the course.

It is not enough to have merely agricultural knowledge. Much of the prejudice encountered by advocates of agriculture in the high school has been due to the teacher's lack of agricultural experience and definite information about rural conditions. He should be able to meet farmers on common ground and discuss their problems intelligently. Many agricultural colleges are requiring farm experience as a condition of graduation. It would not be unwise to require such experience of the teacher of agriculture in the high school.

A qualification most frequently lacking in the teacher of agriculture is proper training in the principles of education and the methods of teaching. Perhaps more failures in teaching are due to lack of proper methods than to lack of a knowledge of subject matter.

The danger of assigning the teaching of agriculture to the science teacher, who happens to have been raised on the farm, or to some teacher who happens to have a vacant period, is readily apparent. In addition to a careful training in the science and practice of agriculture, and in the pedagogy adapted to the subject, the teacher should have energy, resourcefulness, enthusiasm, and ability to meet the patrons of the school in social and business relations. With such a teacher failure of the department will be impossible.

To get such a teacher, the pay must be commensurate with the service. School boards should expect to pay at least \$100 per month for a man who can teach agriculture to both the pupils and the patrons. It is very desirable, too, that the teacher be employed for the entire year, so that he can supervise project work with the pupils, care for the school farm, and do community work during the summer.

EQUIPMENT.

It is a mistake to suppose that a teacher is all that is needed to make agriculture in the high school fulfill its mission. There is as much need for suitable equipment in this subject as in other sciences in the high school. When the department is introduced, it is well to equip it with at least five acres of land and the necessary tools, laboratory equipment, and library books. A list of these necessities is given elsewhere in the bulletin. Do not expect the teacher to "make bricks without straw."

STATE AID.

In accordance with Section 3, Chapter 26, Acts of the Thirty-second Legislature, the State Board of Education is authorized to duplicate, by appropriation out of money provided for that purpose by the Legislature, an amount varying from \$500 to \$1,500 that has been set apart by the trustees of a public high school of first or second class, as designated by the State Department of Education, for establishing, equipping, and maintaining a department of agriculture. For high schools of the third class the amount ranges from \$500 to \$1,000.

Success in obtaining state aid depends upon two conditions: provision by trustees for meeting the legal requirements as interpreted by the State Department of Education, and the existence of a fund available for aiding high schools. The first condition is under the control of the district. It includes provision for the ownership of at least three acres of land conveniently located and suitable for garden and field crops; for the employment of a "teacher who has received special training for giving efficient instructions"; for the purchase of the required laboratory, field, and library equipment; and for maintenance of the department after state aid is withdrawn. An application blank for state aid will be sent by the State Superintendent to those requesting it. After the school has been investigated and approved by the State Superintendent, his report and recommendations are made to the State Board of Education, which body has the authority to grant aid within the limits prescribed by law.

The second condition mentioned above depends upon the amount of money provided for this purpose and upon the number of schools qualifying for aid. The appropriation of \$100,000 for aid to manual training, domestic science, and agriculture for the two years, 1913-14 and 1914-15, is proving much too small to meet the requests from eligible schools.

The purpose of the aid to high schools is chiefly to assist the district in providing for land and other permanent equipment needed for

the proper teaching of the subject. The law provides that an appropriation is not to be made more than twice to the same school, and that the district shall give evidence that it will be able to continue the work after state aid is withdrawn. Administration officers should not make the mistake of using the state aid and the duplicated sum to pay the salary of the teacher without providing for sufficient permanent equipment.

ADAPTATION OF COURSES IN AGRICULTURE TO LOCAL CONDITIONS.

SCOPE OF COURSE.

It is desirable that the whole field of agriculture be covered in the high school course, regardless of the number of units of work offered in the subject. If only one year is given to agriculture, the course should be general and all phases of the subject, such as agronomy, horticulture, animal husbandry, etc., should be touched upon. The longer the time devoted to the subject, the more the various units of subject matter may be differentiated into separate courses.

The amount of emphasis to be put upon any phase of the subject will depend upon several factors: the qualifications of the teacher; the local interest and local need; the laboratory, field, and library equipment available, etc. It is better that a teacher teach more of such subject matter as he knows and teaches well than that he attempt something he is unfitted for, merely because it is desirable to have the additional subject matter in the course. In some communities in the State, local interest and the importance of live stock justify one and one-half units or even two units in animal husbandry; while in other communities offering the same amount of agriculture, the subject of animal husbandry may be dismissed in one-half unit. In the same way horticulture may vary greatly in importance in different parts of the State. Agronomy will be relatively important in all parts of the State, for soils and crops are strictly fundamental in agriculture. Much time is wasted by not having material or equipment necessary to render the teaching concrete and easily intelligible. It will not pay to give a long-drawn-out course in types and breeds of farm animals unless animals are available in the community to illustrate those types and breeds. More judging of live stock can be taught in a few minutes with the live stock before the students than can be learned in several hours, perhaps, by reading the text alone. Actual pruning of the grape will be more effective than merely reading about pruning. It is waste of time to try to learn how to judge corn with no corn to judge. Many of these things we learn best by doing.

Thus it is apparent that it is impossible to suggest an agricultural curriculum that will be entirely satisfactory in all localities, for all schools, and for all teachers. An effort will be made to make a satisfactory solution of the problem, assuming that the teacher is well-rounded in training, the school is well equipped, and the agricultural interest in the community is diversified.

COURSES IN AGRICULTURE.

In the arrangement below, schools have been grouped according to the number of units of agriculture offered. Elementary botany has been considered as a part of the courses, while the traditional subjects

of zoology, physical geography, physiography, chemistry, and physics are to be considered in addition to the work indicated. It is assumed that a year's work in general agriculture has been done in the elementary school.

GROUP I. (One unit)

<i>First Term</i>	<i>Second Term</i>
General agriculture	General agriculture

GROUP II. (Two units)

	<i>First Term</i>	<i>Second Term</i>
First year	Insects, soils, plants	Crops (field, garden, fruits,) and home grounds
Second year	Live stock (judging types and breeds; feeding; breeding)	Live stock (judging types and breeds; dairying; poultry)

GROUP III. (Three units)

	<i>First Term</i>	<i>Second Term</i>
First year	Botany	Plant propagation and vegetable gardening
Second year	Live stock (judging types and breeds; feeding; breeding)	Live stock (judging types and breeds; dairying; poultry)
Third year	Soils and field crops	Fruits, insects, home grounds

GROUP IV. (Four units)

	<i>First Term</i>	<i>Second Term</i>
First year	Botany	Plant propagation and vegetable gardening.
Second year	Live stock (judging types and breeds; feeding; breeding)	Live stock (judging types and breeds; dairying; poultry)
Third year	Soils	Field crops
Fourth year	Fruits, insects, diseases	Farm mechanics, farm management, and home grounds

In Group I. are those schools that are offering only one year's work in agriculture in the high school. This course is supposed to include the work given in any good high school text in general agriculture, such as Warren's *Elements of Agriculture*. All phases of the subject should be studied. The emphasis upon each unit of subject matter will depend upon numerous matters, among which local importance and available time are important. For some classes the course may be largely cultural, while for other classes it may be made extremely practical. Every high school, whether in city or country, should offer at least one unit in agriculture for its cultural and avocational value, if not for its vocational value. Even though a school is offering four units of technical agriculture, it is yet desirable to offer a course in general agriculture to be taken by those students who do not care to elect the more detailed study of each phase of the subject. Such a course is especially desirable for city schools for the broadening influence upon the students and for the appreciation of rural life and conditions to be secured.

The course outlined for Group II. is suited to those schools that offer only two years' work in agriculture. The supposition is that no botany

is offered as a separate subject. This arrangement will be very satisfactory for the schools offering only two years in high school work. With some modifications this course can be adjusted to schools offering a year's work in botany or biology. If only the two units of agriculture are offered, they may be assigned to any year in the course. In some localities the live stock work might be reduced to one-half unit to give more time to crops, etc.

In Group III. a much more satisfactory course is made possible by the addition of the third year's work. A better foundation for work in the different kinds of crops is secured by a definite course in elementary botany. The work in plant propagation and vegetable gardening is very desirable in the first year of the high school. This work appeals strongly to the adolescent's desire for activity and concrete application, and thus tends to lessen the number of withdrawals. The least satisfactory part of the course is the effort to give soils and field crops in a half year. In many communities the fruit production could be emphasized less and field crops could be continued into the second term. There may be localities in the State where the live stock industry would not justify devoting one-third of the time of the course to it. The arrangement recommended is intended for those communities where all phases of agriculture are important and where farming is diversified. If there is found a locality where cotton is the only product of interest, other phases of agriculture should be taught the rising generation and the importance of diversifying should be shown them; but perhaps it would not be justifiable to devote so much time as is indicated above.

In Group IV. all the advantages of Group III. are found, and in addition much stronger work is made possible in soils and field crops by assigning a half-year's work to each. Another very desirable addition is made to the course by offering the work in farm mechanics and farm management. This makes a very fitting climax to the work of the student in agriculture.

For the sake of the students who are agriculturally inclined and who do not expect to go to college, it cannot be urged too strongly that the high schools should offer a course similar to the one outlined in Group IV. Young men who have taken such a course under the direction of a suitable teacher in a school with adequate equipment will go out to make success of farming and will put agriculture and rural life on a higher plane in their communities.

In some schools it may be desirable to differentiate out other units of subject matter, and arrange them in a different manner. A half-unit in dairying and a half-unit in poultry may easily be separated from the live stock course outlined above, leaving feeding, breeding, and judging of types and breeds. Or a half-unit in economic entomology is very satisfactory. A half-unit in landscape gardening should appeal to every pupil in the high school. For a few very select schools, six units in agriculture might be offered, allowing credit in all towards graduation, or permitting certain options in the agricultural subjects. For such schools the first year of the course might remain as outlined in Group IV. During the second year the live stock course might be given with the work in dairying and poultry omitted. During the third

year a half-unit in soils and a half-unit in poultry might be given the first term, and a half-unit in field crops and a half-unit in dairying might be given the second term. During the fourth year the first term's work might consist of a half-unit in fruit production and a half-unit in economic entomology, and the work of the second term might be a half-unit in farm management and farm mechanics, and a half-unit in landscape gardening. It is not recommended that such a course be offered except in a very rare case. A school may be unusually fortunate in teacher and equipment, and there may be a desire to attract with the agriculture the youth who have been out of school several years. These young men may return for the agricultural work alone. Suggested outlines for these courses appear later in the bulletin.

AGRICULTURAL CURRICULA FOR HIGH SCHOOLS.

Opinions differ widely as to the best program of studies for a high school. There are numerous factors that have an influence in determining the desirability of any certain choice. School men generally used to insist on curricula that were almost entirely prescribed. Students were required to select a certain group of subjects out of two or more groups offered, and to pursue the subjects prescribed in that group. Too many schools are still following this policy. The narrow, prescribed curricula in our high schools may be largely responsible for the large number of withdrawals of pupils. The tendency in educational thought is strongly in favor of a plastic program of studies that will permit a great variety of curricula. In the smaller high schools, where the small number of teachers limits the number of subjects that can be taught during any term, the election may be made by classes rather than by individuals.

Again, the number of units required for graduation varies from sixteen to twenty. The leaders in education are strongly in favor of sixteen. Certainly not more than eighteen units should be required for graduation. It is safe to assume that little more work is done when twenty units are required for graduation than when only sixteen are required. Usually the difference lies in the depth to which the subject is explored.

The following suggests a program of studies from which the individual student under the advice of his teacher may select a very satisfactory curriculum. Not all schools would be expected to offer as much work as is indicated below.

	<i>Required</i>	<i>Elective</i>
First year		(Elect 1 or 1 1-2 units)
	English I	Latin
	Algebra I	Agriculture
	Ancient history	*Biology
		or
		{ Physical Geography 1-2
		{ Physiology 1-2
		Manual Training 1-2
		Domestic Economy 1-2

*Biology may be given in the first or second year as the teacher may desire, physical geography and physiology being given the other year.

	<i>Required</i>	<i>Elective</i>
Second year	English II Algebra II	(Elect 2 or 2 1-2 units) Latin Med. and Mod. History Agriculture Biology or { Physical Geography 1-2 Physiology 1-2 Manual Training 1-2 Domestic Economy 1-2
Third year	English III Plane Geometry	(Elect 2 or 2 1-2 units) Latin Spanish German English History Chemistry Agriculture Manual Training 1-2 Domestic Economy 1-2
Fourth year	English IV	(Elect 3 or 3 1-2 units) Latin Spanish American History and Civics Mathematics Physics Economics Teachers Training Course Manual Training 1-2 Domestic Economy 1-2

(All students should be required to offer two units in history and one unit in science for graduation. Three or four units in a modern language may be desirable in certain localities.)

ALTERNATION OF SUBJECTS.

For the small school there is always difficulty in offering a large variety of subjects from which to choose. Many superintendents dispose of the matter by limiting the program of studies to the traditional subjects of four years in English, four years in Latin, four years in mathematics and four years in history. Other school men reduce the length of the recitation period and overload the teacher. Too much cannot be said against the folly of thirty-minute recitation periods and ten or more recitations per teacher in the high school. Alternation of subjects is the best solution of the problem.

The considerations that will decide the desirability of the proposed alternation are (1) whether the combined classes of students can be handled in less time because of the alternation, and (2) whether there is a special hardship worked upon any class of students in not having had a subject that is scheduled earlier in the course. The first consideration depends upon the number of pupils; the second depends upon the relation between the two subjects to be alternated.

There is no reason why a high school that desires to offer more than one unit of agriculture should limit itself to a single unit, unless the classes are so large that they cannot be combined. In the courses sug-

gested above there can be alternated the first and second years in Group II., the second and third years in Group III., and the second and third years in Group IV. Thus if there is time for one unit in agriculture in the program of recitations, the school can offer two units; if there is time for two units, the school can offer three units, and so on. This permits the work in agriculture to be organized in a much more satisfactory way and gives the student the opportunity to get more vocational work, while no greater demand is made upon the time of the teacher.

Other subjects in the program of studies may be alternated by years also. In the small high schools there is no need for teaching physics and chemistry the same year. American history and civics can alternate with English history, but it is preferable for the student to know English history as a foundation for the high school work in American history. Physiology and physical geography can be alternated without inconvenience. Some will object to alternating third and fourth English, but it has been done very successfully. If the work in algebra to quadratic equations is well done the first year in the high school, plane geometry can follow with no inconvenience, thus permitting an alternation between second algebra and plane geometry.

By carefully planning the alternations that can be made, leaving clear records of the work done by each class and the work to be done the next year, a plastic program of studies offering extensive work in agriculture may be arranged in schools that would otherwise be limited to a very narrow program of studies.

SUGGESTIONS CONCERNING THE MANAGING OF AGRICULTURAL COURSES.

TEXTBOOKS.

One of the great hindrances to introducing more than one unit of agriculture into the high schools is the problem of textbooks. Until recently there were very few suitable texts available for high schools, but during the past two years a number of very commendable efforts have been made to meet these needs of the schools. The courses have not been standardized yet, and books that will do fairly well for one arrangement of the work may be unsatisfactory for another. Local interests are of such influence that no set of texts can be selected that will be entirely satisfactory. It is true to a larger extent, perhaps, in agriculture than in any other part of high school work that the text should be used merely as a basis for work, and the teacher should be larger than the text. It is with an idea of aiding the teacher to be independent of the textbook that brief outlines of the subjects are included in this publication.

One very serious difficulty in the selection of textbooks is the cost to the pupil. The science books usually are relatively expensive; and when two such books costing a dollar and a half or more a piece are required each year in agriculture, the burden becomes heavy on the parent. One solution of this is to put in the library one copy of the text for every three pupils and assign references in the text and other reference books. The danger is that such a method will develop the lecture method of conducting the recitation. Whatever may be the value of the purely lecture method in the college or university, it is safe to say that it is not adapted to high school work. The pupil in the high school needs some text as a basis for his work, even though it may be rather poorly adapted to the needs of the course.

Textbooks for the subjects in Group IV. will be considered first. Reference books will be suggested later.

There are a large number of high school texts in botany. It is hoped that the short course suggested in botany as a basis for the work in crops of different kinds will differ somewhat, at least, from the traditional pure-science botany. Almost any of the good texts can be adapted to the needs of the course by a teacher who knows what he wants to teach. Perhaps the revised edition of Bergen and Caldwell's *Introduction to Botany* (Ginn & Co., price \$1.30), which is just off the press, will require least adaptation. Other satisfactory texts are Bergen and Caldwell's *Practical Botany* (Ginn & Co., price \$1.40), Andrews' *Practical Course in Botany* (American Book Co., price \$1.50), and Bailey's *Botany for Secondary Schools* (Macmillan Co., price \$1.25).

For the second term of the first year, work in plant propagation and vegetable gardening has been suggested. The cost of the books makes it undesirable to have the students buy a text for each of these subjects. The need of a text in vegetable gardening is perhaps more urgent than in plant propagation. Duplicate copies of Bailey's *Nursery Book* (Mac-

millan Co., price \$1.50) should be put in the library for a text. Several copies of Farmers' Bulletin No. 157, *Propagation of Plants*, should be available for the use of the class. It is possible to use Texas Experiment Station Circular No. 3, New Series, *Truck Farming*, as a text in vegetable gardening by supplementing it with books and bulletins in the library. It is recommended that the pupils buy a text in at least one of the subjects for this term. Of the books in vegetable gardening the following can be used satisfactorily as a basis for the work: Green's *Vegetable Gardening* (Webb Publishing Co., price \$1.00), and Bailey's *Principles of Vegetable Gardening* (Macmillan Co., price \$1.50). Whatever text is used, considerable care must be exercised in adapting it to local conditions.

It is usually preferable to make the first year's science in the four-year course in agriculture a study of biology. Many teachers prefer to devote the entire year to botany. This is a good practice if time can be found later for work in zoology and economic entomology. The stronger the students become in botany, zoology, and entomology, the stronger they will be in agriculture. There are a number of texts on biology being used in this year's work. Hunter's *Essentials of Biology* (American Book Co., price \$1.25) is used in many high schools in Texas at the present time, and is a very satisfactory text. Peabody and Hunt's *Elementary Biology* (Macmillan Co., price \$1.25) is also a good text for high school work. Splendid laboratory manuals are published by both companies for their respective texts, and these may be had at a moderate price.

The animal husbandry that is suggested covers the whole subject of live stock. There are perhaps only two books available for this course: Harper's *Animal Husbandry for Schools* (Macmillan Co., price \$1.40) and Plumb's *Beginnings in Animal Husbandry* (Webb Publishing Co., price \$1.25). Either of these books will need to be supplemented by reference books and bulletins. The second, especially, will need to be supplemented greatly for the work on dairying.

For the work in soils and field crops a great variety of books is available. The consideration of economy makes it desirable to find a book that gives satisfactory work in both subjects. Perhaps only one book is available,—Hunt and Burkett's *Soils and Crops* (Orange Judd Co., price \$1.50). This book may be used as a basis for the work, in spite of a very exaggerated formality in the arrangement of the subject matter. The authors assume that fifteen individual recitations can be made during a recitation period and each lesson or chapter has been so constructed as to contain fifteen paragraphs, each paragraph to be the source of a student's recitation. The arrangement of the book would make one think the authors expect the teacher of agriculture to "hear lessons" rather than to teach. In favor of the book is the fact that it contains definite work on soils and on field crops that can be supplemented by bulletins and reference books under the direction of a skillful teacher, and thus the pupil will be saved some expense.

If two books may be required of the pupil, more choice will be possible. For the work in soils perhaps the most satisfactory text is Whitson and Walster's *Soils and Soil Fertility* (Webb Publishing Co., price

\$1.25). Vivian's *First Principles of Soil Fertility* (Orange Judd Co., price \$1.00) might be easily adapted for use. It contains no experiments and demonstrations, and it perhaps overestimates fertilizers, about fifty per cent of the book being given over to the discussion of manures and fertilizers. Snyder's *Soils and Fertilizers* (Macmillan Co., price \$1.25) is well written and gives very desirable work, but the chemistry of the book is too advanced for third-year high school pupils. In the hands of a skillful teacher it might be easily adapted to the needs of the course.

For the work in field crops for the South there is perhaps no satisfactory text. Duggar's *Southern Field Crops* (Macmillan Co., price \$1.75) is an excellent book, but it will require very careful thought for the teacher to adapt it to a half-unit in general field crops. It contains 547 pages of subject matter, and yet does not touch upon the grasses, cowpeas, alfalfa, soy beans, clovers, etc. The work on corn and cotton is very satisfactory for this course, but other parts of the book would need to be abbreviated to give time for supplementary work in the important crops that are omitted. The alternative is to select a book that has been prepared with the Middle States or Northern States in mind, and supplement it extensively in fiber crops and adapt it to Southern conditions. In this class are the following: Livingston's *Field Crop Production* (Macmillan Co., price \$1.50) and Wilson and Warburton's *Field Crops* (Webb Publishing Co., price \$1.50).

There is no suitable text in fruit production adapted to Texas conditions. The teacher must be able to take a general text and adapt it to the needs of the community. It would be difficult to prepare a text that would be entirely satisfactory for the varied horticultural conditions in Texas. Texas Department of Agriculture Bulletin No. 32, *A B C of Fruit Growing*, will be of great value to the teacher and may even be used by the class as a text. Among the books that may be used for a text should be mentioned Goff's *Lessons in Fruit Growing* (University Coöperative Association, Madison, Wis., price \$1.50), Green's *Popular Fruit Growing* (Webb Publishing Co., price \$1.50), and Bailey's *Principles of Fruit Growing* (Macmillan Co., price \$1.50).

For the work in farm mechanics, farm management, and home grounds there is no text whatever. A delightful little book has just been published that will be very satisfactory as a basis for the farm management, Boss' *Farm Management* (Lyons and Carnahan, price 90 cents). If it be permissible to have the pupils buy two books during the half year, Davidson's *Agricultural Engineering* (Webb Publishing Co., price \$1.50) will serve as a basis for the work in the farm mechanics. More work is offered in this book than there will be time for, but adaptation will be easy. For the few weeks' work, which is very desirable, in improvement and ornamentation of home grounds, reference books and bulletins can be used.

Some of the books recommended above can be used for the corresponding work in courses other than that in Group IV. In Group III. no change need be made from the above, except that Hunt and Burkett's *Soils and Crops* (Orange Judd Co., price \$1.50) is the book that would naturally be selected. In Group I. the state-adopted text, Warren's *Elements of Agriculture* (Macmillan Co., price \$1.10), is the text re-

quired by law, and is very satisfactory. In Group II. it will be possible to use Warren's *Elements of Agriculture* for the first year. The first nine chapters should form the basis of the work. Much supplementary work should be given, especially in the elements of botany. Clute's *Agronomy* (Ginn & Co., price \$1.00) is very satisfactory for the first half of this year's work, but there is no book suitable for the work in general crops. One of the books on field crops may be used by supplementing it for horticultural crops. For the second year a text in animal husbandry should be selected.

Still other arrangements of the subject matter may be desirable in some localities. If a half-unit course is offered in dairying, Michels' *Dairy Farming* (the author, Milwaukee, price \$1.00) will be found satisfactory. Wing's *Milk and Its Products* (Macmillan Co., price \$1.50) or Van Slyke's *Modern Methods of Testing Milk Products* (Orange Judd Co., price \$1.00) may be used by supplementing it extensively in the study of milk production. If a half-unit is given to poultry, Watson's *Farm Poultry* (Macmillan Co., price \$1.50) will be a satisfactory text. Robinson's *Principles and Practices of Poultry Culture* (Ginn & Co., price \$2.50) and Lewis' *Productive Poultry Husbandry* (Lippincott Co., price \$2.00) are excellent texts, but are a little heavy for the high school, and the prices are against them. For a half-unit in landscape gardening Waugh's revision of Kemp's *Landscape Gardening* (John Wiley & Sons, price \$1.50) is available, but it will need to be supplemented by a study of ornamental plants. Another very satisfactory little text is Waugh's *Landscape Gardening* (Orange Judd Co., price 75 cents). This text will need a great deal of supplementary work. In some communities a course in economic entomology will be very popular. There seems to be no very satisfactory book for this course. Perhaps the best plan will be to select such a book as Sanderson and Jackson's *Elementary Entomology* (Ginn & Co., price \$2.00) and supplement it with bulletins and with such a book as Sanderson's *Insect Pests of Farm, Garden and Orchard* (Wiley & Sons, price \$3.00) for most of the economic forms.

NOTEBOOKS.

It is important that notebooks in the different subjects in agriculture be kept carefully and accurately. In addition to the record of all experiments performed and other practice work done, the notebook might contain notes on supplementary work given by the teacher, notes on a special report made by a member of the class, a general outline of the subject matter of the course, accounts of field trips, etc., and abstracts or outlines of all assigned readings other than the text. It is worth while to require neat drawings and careful tabulations of data. All notes should be written in ink. The notebook should be such that the pupil will value it after the school course is finished.

RECITATION PERIODS.

The amount of time that should be given to the recitation and the laboratory work each week will vary slightly with the subject. There

should be five recitations or their equivalent each week. In the major part of the work it will be best to give three single periods to recitations, and two double periods to laboratory or field work, each week.

COLLECTED MATERIAL, EXHIBITS, ETC.

An agricultural laboratory should present somewhat the appearance of an agricultural fair in the great variety of products, exhibits, and other educational materials that have been collected and preserved. Much of this material will be needed from time to time to make concrete the textbook work. Some of it will be a silent means of educating the pupils and the visiting patrons. It is a reflection upon the teacher when there is found upon the shelves and in the cases in the laboratory only a few bottles of beans and peas and a few inferior ears of corn. There are listed below a few of the numerous collections that should be in every laboratory. By no means can a teacher and the classes be expected to complete such a list in one year, but a start should be made, and additions should be made from time to time as opportunity presents itself.

1. Herbarium—mounted and named specimens.
 - a. Various grasses in the community.
 - b. Various weeds in the community.
 - c. Various wild flowers in the community.
2. Collections of agricultural pictures, charts, etc.
3. Bottled specimens.
 - a. Fertilizers.
 - b. Feeds.
 - c. Insects.
 - d. Types of soil.
 - e. Seeds (farm crops, garden, weed, acorns, pecans, etc.).
 - f. Corn products.
 - g. Cotton seed products.
 - h. Fruits.
 - i. Diseased fruits, twigs, etc.
 - j. Spray materials.
4. Permanent mounts of types of wheat, barley, oats, etc.
5. Commercial classes of cotton.
6. Variety ears of corn.
7. Varieties of wheat, oats, cotton, etc.
8. Mounted insects.
9. Excellent and poor types of ears of corn.
10. Types of corn kernels as to shape.
11. Models of poultry house, dairy barn, septic tank, etc.

VISITS AND FIELD TRIPS.

That time should be devoted to field trips and visits, cannot be emphasized too strongly. It is important that the pupils be given opportunity to observe as much as possible of the practical side of agriculture in all its phases. Excursions and visits can frequently be planned for Saturday when time on school days cannot be arranged. Careful notes

of all such work should be inserted in the notebooks. Some of the numerous visits and trips that will be valuable are the following: trips to greenhouses and parks, nurseries, truck gardens and markets, stock farms, stock yards, fairs and shows, dairies, creameries, poultry farms, poultry yards and markets, orchards and fruit markets, implement houses, typical farms, agricultural colleges and experiment stations; and to fields to study soils, crops, insects, weeds, etc.

PROJECT WORK.

There is a great opportunity for the teacher of agriculture to accomplish valuable results with his students in so-called project work or part-time work. The term *part-time* indicates that part of the work of the student is done in school and part out of school. A certain project is undertaken by the students under the supervision of the teacher. The scientific principles involved are carefully studied, and plans are outlined in detail; the work is done, observations are made, notes are recorded, and a complete report of the project is submitted to the school. The student, assisted by the expert advice of his teacher, has put into practice on his own farm or on the school farm under a specific set of natural conditions, certain principles involved in his agricultural course.

This sort of work is thoroughly practical and will serve to rob the pessimist's derisive "book farming" of its stigma. Project work puts the boy into actual farm problems, where more or less expenditure of money is necessary and where incomes may be expected. School work assumes an appearance of business life that proves very attractive to the adolescent.

Some project work could be completed during the school session, but much of it will continue into or through the summer. This makes it very important that the teacher should be employed for the year, so that he may supervise his students' projects during the summer as well as during the school session.

The giving of school credit for project work is a matter that the individual teacher must work out for his school. Each agricultural subject may be made to include a certain amount of project work, just as it includes laboratory work. Credit in the subject may be withheld until the project has been finished and reported. An extra number of units for graduation may be adopted—eighteen instead of sixteen, for instance. The additional two units may be made by taking subjects in the curriculum, by doing some project work, or by doing some other work out of school, but with the approval and under the supervision of the school, such as music, art, printing, painting, etc. Still another method is to allow honor credits as special distinction for the students who have done work in addition to the work in the curriculum.

The project work may be divided into three general classes: (1) production, (2) demonstration, and (3) improvement. In some cases the project may include all of the features. A few examples of this kind of work are listed below. These will suggest many more.

Production Projects:

1. Growing an acre of corn, cotton, tomatoes, potatoes, etc.
2. Developing an acre of alfalfa.

3. Starting an orchard,—peaches, figs, plums, etc.
4. Producing a berry patch,—strawberries, blackberries, etc.
5. Pruning, spraying, and managing an orchard.
6. Care of a dairy cow.
7. Care of 25 hens for egg production.
8. Growing chicks for market.
9. Care of brood sow and litter.

Demonstration Projects:

1. Use of lime on land.
2. Grafting and budding certain kinds of trees.
3. Treatment of oats for smut.
4. Treatment of potatoes for scab.
5. Testing new varieties.
6. Comparison of sprayed and unsprayed orchards.
7. Comparison of different rations.
8. Deep and shallow cultivation.

Improvement Projects:

1. Developing a lawn.
2. Planning and executing a landscape design.
3. Cement work,—walks, posts, troughs, etc.
4. Replanning a farm.
5. A plan for water system, bath and sewage in farm home.
6. Construction of buildings, gates, etc.

Space does not permit a detailed discussion of this work. Massachusetts has done more, perhaps, than any other state in securing this close relation between school and home in agricultural work. Valuable literature on the subject may be secured by writing to the State Department of Education at Boston. United States Bureau of Education's *Bulletin*, 1914, No. 8, is an explanation of the Massachusetts plan.

SCHOOL FARM.

The school should have at least three acres suitable for field and horticultural crops, conveniently located for the use of the students. Larger farms will be desirable if the farm is to be run on a commercial basis and if live stock are to be kept for the use of the school. It is possible for the school to employ a foreman or farmer and run a large farm under the supervision of the teacher of agriculture, and to make the farm pay the expenses of the department of agriculture in the school. This, however, involves a dangerous risk. The teacher will have many things to demand his time and attention, and the purely school duties may suffer. In general the farm should be looked upon as a part of the equipment of the school for teaching agriculture, and all commercial considerations should be secondary at least.

Too much emphasis cannot be placed upon the value of the school farm in appealing to the interests of the adolescent and in teaching the principles of agriculture. Not all people can have the pleasure of

owning and handling live stock, but everyone with only a few square feet of ground, or with only a window box, can have plants to fondle and care for. It is in the school garden that the appreciation of plants can be made keener and the theories can be put into practice.

The school farm should be made the most interesting spot in the community. It should be a means of education to the community in general as well as to the members of the agricultural classes. If it has been managed properly, it will be a favorite place for young and old alike to visit on Sundays, holidays, etc., to read the labels explaining the nature of the experiments and demonstrations, and to observe the progress of the different crops. Woe to the teacher whose field and garden plots are such that the returning crowds give a sneer of disgust! On the other hand, when everything shows plan, order, skill and attractiveness, a favorable report will be heralded far and wide and the occasional grouch will change his attitude.

The work on the farm presents a hard problem. The laboratory periods should be used for that part of the work that is clearly of sufficient educational value to justify the use of part of the school day. It is preferable that all of the work be done by the students, but the purely manual labor that is relatively low in educational value should be done outside of the two double periods a week assigned to the field and laboratory work. Each student may be held responsible for all the work in his or her individual plot after the ground has been broken and harrowed. For work on the farm other than the individual plot, moderate wages may be paid, participation in the proceeds of the ground may be allowed, or the community spirit of the school may be so developed that the work will be donated and the proceeds used for equipment, library, improvements, athletics, etc.

There are numerous uses to which the farm may be put. Space will not permit a detailed discussion of the subject. A few uses are listed with very few comments.

1. Garden plot.—Provide individual plots for high school classes. Satisfactory size is about 12x40 feet. Plant rows the short way. Arrange crops according to the principles of succession of crops and of companion cropping. Use a wide range of plants.

2. Grass gardens.—This should contain all the economic grasses of the country; Bermuda, Johnson grass, Sudan grass, timothy, blue grass, orchard grass, rescue grass, etc. The purpose is that it should serve as a sort of exhibit of living grasses. Label all plainly.

4. Legume garden.—This should contain all the legumes of importance as field crops.

4. Sorghum garden.

5. Cereal garden.

6. Variety gardens.—Use separate gardens for varieties of corn, cotton, wheat, oats, etc.

7. Nursery.—The classes in plant propagation will need material to work upon. Seedlings may be grown for grafting, budding, etc. It may be made somewhat commercial.

8. Berry patches.—Strawberries, blackberries, dewberries, etc., may be grown for work in propagation, pruning, etc., for the educational value of knowing them, and for commercial profit.

9. Orchard.—This should include at least a few of all fruit trees that will grow in the community. The purpose is educational, for experience in propagation, pruning, etc.; and it may be for profit.

10. Vineyard.—This should be large enough to give experience in pruning, etc.

11. Crop rotation test.—At least 1-20 acre plots should be used; 1-10 acre plots will be better. The following experiment is suggested:

ROTATION OF CROPS.

Plot	First Year	Second Year	Third Year
I	Corn	Corn	Corn
II	Oats	Oats	Oats
III	Cotton	Cotton	Cotton
IV	Corn	Oats followed by cowpeas to be plowed under	Cotton
V	Oats followed by cowpeas to be plowed under	Cotton	Corn
IV	Cotton	Corn	Oats followed by cowpeas to be plowed under
VII	Corn, 200 pounds acid phosphate per acre	Oats followed by cowpeas to be plowed under	Cotton, 200 pounds acid phosphate per acre
VIII	Oats followed by cowpeas to be plowed under	Cotton, 200 pounds acid phosphate per acre	Corn, 200 pounds acid phosphate per acre
IX	Cotton, 200 pounds acid phosphate per acre	Corn, 200 pounds acid phosphate per acre	Oats followed by cowpeas to be plowed under

12. Fertilizer Test.—Size of plots should be the same for crop rotation tests. The following experiment is suggested:

PLAT NUMBER AND FERTILIZER.

- (1) No fertilizer.
- (2) Nitrate of soda, 100 pounds per acre, or cotton seed meal, 200 pounds per acre.
- (3) Acid phosphate, 200 pounds per acre.
- (4) Sulphate of potash, 100 pounds per acre, or muriate of potash, 100 pounds per acre.
- (5) No fertilizer.
- (6) Nitrate of soda, 100 pounds per acre, or cotton seed meal, 200 pounds per acre, and sulphate or muriate of potash, 100 pounds per acre.
- (7) Nitrate of soda, 100 pounds per acre, or cotton seed meal, 200 pounds per acre, and acid phosphate, 200 pounds per acre.
- (8) Acid phosphate, 200 pounds per acre, and sulphate or muriate of potash, 100 pounds per acre.

(9) No fertilizer.

(10) Nitrate of soda, 100 pounds per acre, or cotton seed meal, 200 pounds per acre, and acid phosphate, 200 pounds per acre, and sulphate or muriate of potash, 100 pounds per acre.

(11) Stable manure, ten tons per acre.

(By special arrangement schools may be able to secure fertilizers free of charge from the State Chemist at College Station for a cooperative experiment similar to the above.)

13. Ear-to-vow and plant-to-vow tests.—Develop high-yielding strains of corn and cotton. Plant the improved seed to raise seed for sale. For method of procedure consult Duggar's *Southern Field Crops*.

14. Hill test of potatoes.—Develop high-yielding strain.

15. Test out new varieties of crops.

16. Cultivation tests.—Try deep and shallow cultivation, dry methods of farming, ridging, and listing.

17. Model kitchen garden.

18. Student project work.

19. Production of feed for school stock.

20. Poultry yards, barn, and barn yard.

21. Commercial production.

a. Nursery supplies of apples, peaches, figs, etc.

b. Truck crops.

c. Hot bed plants for garden and flower beds.

d. Pure bred seed—corn, cotton, oats, potatoes, etc.

Care should be taken to label plainly and neatly all experiments, demonstrations, and exhibits so that the greatest educational value will result to the community. Labels made by nailing a 10x18x1-inch board across a 2x4-inch stake are satisfactory. The labels should be painted white and lettered in black. Line the labels so the grounds will have an orderly appearance. The appearance of the field may be improved still further by framing in at least part of the field with a border of ornamental shrubs and flowers. The border can be developed year by year until at least the school garden is surrounded by a well planned border.

COMMUNITY AND EXTENSION WORK.

The public school system of the United States is beginning to realize that it has responsibilities outside of the school room. Various lines of so-called extension work are being carried on by the schools in some localities. The department of agriculture in the high school has an almost unlimited field in this work. Not only is there the opportunity, but it is the duty of the teacher of agriculture to include the community in his field of endeavor.

To do this extension work well requires a combination of qualifications that is not always found in a teacher. The man must be well trained in agriculture, must know how to solve the local problems, must be able to talk easily and forcefully, and must be able to associate with the people of the community and impress them with his interest in their problems and with his ability to help them.

The teacher of agriculture should not fail to cooperate with every

agency in the community that is helping in the uplift of community life. There are men and women sent out by the state institutions and by the United States government who will be willing to assist in every undertaking. Those schools located in counties that have a farm demonstration agent and a canning club agent are very fortunate. The coöperation between the school and these agents should be very close. Each can assist the other, and the community will profit greatly in the result. The sub-stations of the experiment station can be used in many ways by the schools within reach of them.

There are listed below some of the various lines of work that have been found satisfactory in different localities:

I. Work with farmers:

1. Farmers' clubs (horticultural, animal husbandry, etc.).
2. Farmers' week and short course.
3. Field and orchard demonstrations (pruning, grafting, spraying, treatment of smuts, potato scab, etc.).
4. Coöperative experiments on farms.
5. Good seed distribution (orders).
6. Milk testing, records of herds.
7. Planning buildings.
8. Introduction of improved live stock.
9. Seed testing.
10. Home decoration and improvement.
11. Sanitation of home.
12. Farm visits on request.
13. Hog cholera serum demonstration.
14. Dipping demonstration.
15. Keeping farm accounts.
16. Balancing rations.
17. Growing pure-bred seeds.
18. Planning rotation of crops.
19. Planning farms.
20. Planning kitchen garden.
21. Treatment of fence posts.
22. "For sale" and "want" lists.
23. Nursery supplies, etc., for sale.
24. Traveling agricultural library.
25. Demonstration of tile drainage.

II. Work with women and women's clubs.

1. Short courses in poultry, vegetable gardening, landscape gardening, etc.
2. Civic improvement.
3. Landscape gardening.
4. Coöperative experiments in poultry, vegetables, flowers, etc.

III. Work with young people.

1. Short courses.
2. Agricultural clubs, contests, shows, etc.

3. Nature study clubs.
4. Literary societies.
5. Clean-up day, etc.
6. Field day.
7. Bird day.
8. Arbor day.

IV. Work with rural and elementary school teachers:

1. Agricultural study classes.
2. Nature study rambles.
3. Lessons and experiments in agriculture.
4. School rallies.

V. Other lines of community work:

1. Newspaper articles.
2. Agricultural supplements to local paper.
3. Bulletins.
4. Use of concrete on the farm.
5. Demonstration of septic tank.
6. Models of poultry house, dairy barn, etc.
7. Forms for concrete silos (to be loaned or rented to farmers).

No one teacher can engage in all these lines of work at once. Perhaps there are few teachers who will be qualified to do well such a variety of work. Yet, every teacher should attempt some community work. He should select from the things he can do well those things that are most needed in the community. He should not attempt too many things at once. He should do well everything he attempts.

SYLLABI AND EQUIPMENT.

USE OF OUTLINES.

It is not expected that the following outlines will be followed verbatim by any teacher. They are intended to be suggestive, and to show something of the scope of work that should be done. It is impossible to make an outline that will be entirely satisfactory for every locality in Texas. It is hoped that the suggestions will aid the inexperienced teacher to adapt rather unsatisfactory textbooks to use in high school agriculture under Texas conditions. Inquiries concerning the adaptation to local conditions will be gladly answered.

REFERENCE BOOKS, ETC.

At the end of each outline is suggested a list of books and bulletins that should be in the library. In some cases it will be more desirable to have duplicate copies of one book than to have one copy each of several. No school should be content with less than the minimum list suggested. Additions should be made as fast as opportunity can be found. The publications of the United States Department of Agriculture can be obtained, usually free of charge, from the Congressman of the district or from one of the United States Senators. From five to ten copies of many of these bulletins should be secured for the library. Should no free copies of the bulletins be available, the Superintendent of Documents, Washington, D. C., will supply them at a very moderate cost. From Gaylord Brothers, Syracuse, N. Y., can be procured paste-board bindings that will greatly increase the life of the bulletins. Usually book companies that make a specialty of books will give at least ten per cent discount to schools. When the order from the different companies is small, it may be more satisfactory to send the entire order to a wholesale company, such as A. C. McClurg or the Book Supply Company of Chicago, or Baker and Taylor of New York. It may be that the Southern Book Depository or the Texas School Book Depository of Dallas can fill the order.

PUBLICATIONS FOR TEACHERS OF AGRICULTURE.

1. Bricker: *The Teaching of Agriculture in the High School.* (Macmillan Co., Dallas, Texas), \$1.00.
2. Davis: *Agricultural Instruction in the Public High Schools.* (The University of Chicago Press, Chicago, Ill.), \$1.00.
3. Hummel: *Materials and Methods in High School Agriculture.* (Macmillan Co., Dallas), \$1.25.
4. Robison: *Agricultural Education in the Public Schools.* (Teachers College, Columbia University, New York), \$1.50.
5. Bulletin, 1913, No. 6: *Agricultural Instruction in High Schools.* (U. S. Bureau of Education.)
6. Bulletin, 1912, No. 6: *Agricultural Education in Secondary Schools.* (U. S. Bureau of Education.)

7. Bulletin, 1913, No. 14: Agricultural Instruction in Secondary Schools. (U. S. Bureau of Education.)
8. Bulletin, 1912, No. 44: Agriculture in Rural Schools. (Michigan Agricultural College, E. Lansing, Mich.)
9. A Year in Agriculture in a Rural Vermont High School. (Middlebury College, Middlebury, Vt.)
10. Circular 106: American System of Agricultural Education. (U. S. Dept. of Agriculture.)
11. Bulletin No. 6: Agricultural Project Study Bibliography. (State Board of Education, Boston, Mass., 1912.)
12. Bulletin, 1912, No. 4: Agricultural Project Study. (State Board of Education, Boston, Mass.)
13. Farmers' Bulletin No. 385: Boys and Girls' Agricultural Clubs. (U. S. Dept. of Agriculture.)
14. Bulletin, 1912, No. 28: Cultivating the School Grounds in Wake, North Carolina. (U. S. Bureau of Education.)
15. Bulletin No. 11: A Course in Agriculture for the High Schools of Michigan. (Michigan Agricultural College, Department of Agricultural Education, East Lansing, Mich.)
16. Courses in Agriculture for High Schools and Academies in Maine. (Department of Education, Augusta, Me.)
17. Circular 84: Education for County Life. (U. S. Department of Agriculture.)
18. Bulletin No. 11: H. S. Series, High School Courses in Agriculture. (University of Wisconsin, Madison, Wis.)
19. Bulletin, 1912, No. 10: Junior Agricultural Association of Michigan for Boys and Girls. (State Department of Education, Lansing, Mich.)
20. Laboratory Exercises in Secondary School Agriculture. (Department of Education, Augusta, Me.)
21. Manual of Agriculture. (Department of Education, Montpelier, Vt.)
22. 1915, No. 9: Project Study Outlines for Vegetable Gardening. (State Board of Education, Boston, Mass.)
23. Public School Agriculture. (Massachusetts Agricultural College, Amherst, Mass.)
24. Circular No. 77: A Secondary Course in Agronomy. (U. S. Dept. of Agriculture.)
25. Circular 91: Secondary Education in Agriculture in the United States. (U. S. Dept. of Agriculture.)
26. Bulletin No. 160: School Gardens. (U. S. Dept. of Agriculture.)
27. Bulletin No. 204: School Gardening and Nature Study in English Rural Schools and in London. (Department of Agriculture.)
28. Syllabus for Secondary Schools, Agriculture. (Department of Education, Albany, N. Y.)
29. Bulletin No. 36: Secondary Course in Agriculture. (State Department of Education, St. Paul, Minn.)
30. Circular 60: Teaching of Agriculture in the Rural Common Schools. (U. S. Dept. of Agriculture.)

31. Bulletin No. 2: Tentative Course of Study in Industrial Subjects for the Public Schools of Indiana. Agriculture. (State Department of Education, Indianapolis, Ind.)
32. Circular 118: The Work of the Agricultural Colleges in Training Teachers of Agriculture for Secondary Schools. (U. S. Dept. of Agriculture.)
33. Farmers' Bulletin No. 586: Collection and Preservation of Plant Material for Use in the Study of Agriculture. (U. S. Dept. of Agriculture.)

PLANT PROPAGATION.

I. Introduction.

1. Definition.
2. Plants according to life cycle: annuals, biennials, perennials.
3. Method of plant growth in circumference and in length.
4. Buds,—location, variation, importance.
5. Art of plant propagation versus science of plant propagation.

II. Methods of plant propagation.

A. By buds.

1. On their own roots, or layerage.
 - (1) Root tips, as in blackberry, etc.
 - (2) Runners or stolons, as strawberries, Bermuda, etc.
 - (3) Layering,—single, continuous, compound or serpentine, mound, pot or Chinese.
2. Separation and division.
 - (1) Separation.
 - a. Character of bulbous plants.
 - b. Description of bulbs, bulbels, bulblets, corm.
 - c. Methods of planting.
 - d. Mutilation of bulbs.
 - (2) Division.
 - a. Definition.
 - b. Description of tuber, crown, rootstock.
 - c. Example of division.
3. Cuttage.
 - (1) Definition.
 - (2) Mystery associated with practice in past.
 - (3) General requirements of cuttings.
 - a. Atmospheric conditions.
 - b. Bottom heat.
 - c. Devices for regulating heat and moisture.
 - (4) Kinds of cuttings.
 - a. Tuber.
 - b. Roots and rootstocks.
 - c. Stems—hardwood, semi-hardwood, soft wood.
 - d. Leaves.
 - (5) Variation of plants as to ease of propagation by cuttage.
 - (6) Formation of callus and roots.
 - (7) Polarity in cuttings.
 - (8) Kind of cuttings best adapted to different plants.

4. On roots of other plants, or graftage.
 - (1) Definition of graftage.
 - (2) Uses of graftage.
 - a. To perpetuate a variety.
 - b. To increase ease and speed of multiplying plants.
 - c. To produce some radical change in nature of habit of scion.
 - (3) Mutual influence of stock and scion.
 - a. Modify stature.
 - b. Adapt plants to adverse soils or climate.
 - c. Correct poor habit of growth.
 - d. Accelerate fruitfulness.
 - e. Modify season of ripening of fruit.
 - f. Increase fruitfulness.
 - g. Delay degeneration of varieties.
 - h. Increase size of fruit.
 - i. Modify color of foliage, flower or fruit.
 - j. Influence the flavor of the fruit.
 - (4) Limits of graftage.
 - (5) Does graftage devitalize?
 - (6) Classification of graftage.
 - a. bud graftage or budding: shield-budding; prong-budding; plate-budding; H-budding; flute-budding; chip-budding; ring-budding; patch-budding.
 - b. Scion-graftage or graftage proper.
 - (a) Grafting as to position, and use of each; root-grafting; crown-grafting; top-grafting; stem-grafting.
 - (b) Grafting as to type, and use of each; whip-grafting; modified whip-grafting; saddle-grafting; splice-grafting; veneer-grafting; side-grafting; inlaying-grafting; cleft-grafting; bark-grafting; cutting-grafting; seed-grafting; double-working; herbaceous-grafting.
 - c. Inarching or grafting by approach.
 - (7) Grafting waxes.
 - a. Preparation and use of wax.
 - b. Preparation and use of waxed strings and bandages.

B. Seedage.

1. Definition.
2. Nature and origin of seeds.
3. Storage of food.

4. Nature of spores.
5. Nature of germination.
6. Requirements for germination.
 - (1) Moisture, its regulation.
 - a. Pots.
 - b. Cultivation.
 - c. Covers: lath screens, glass covers, etc.
 - d. Irrigation,—precaution.
 - (2) Temperature.
 - a. Maximum, minimum, and optimum temperature for different seeds.
 - b. Methods for regulating temperature.
 - (a) Hothouses.
 - (b) Hotbeds.
 - (c) Cultivation, etc.
 - (3) Air or free oxygen.
7. Preparatory treatment of seeds.
 - (1) Stratification, as peach, plum, etc.
 - (2) Soaking, as watermelon, squash, etc.
 - (3) Scalding, as Kentucky coffee bean.
 - (4) Mechanical treatment,—bore hole in canna seed, crack peach and pecan.
 - (5) Acid treatment,—as weak solution of acetic acid.
8. Seed testing.
 - (1) Importance.
 - (2) Kinds of testers.
9. Influences that affect vitality of seeds.
 - (1) Weather: temperature and moisture.
 - (2) Maturity.
 - (3) Curing of seed.
 - (4) Climate.
10. Planting.
 - (1) Soil.
 - a. Kind of soil.
 - b. Physical condition.
 - b. Fertility.
 - (2) Planting in relation to kind of seed.
 - (3) Potting and transplanting.
 - (4) Planting spores.
11. Damping-off fungus.
 - (1) Nature of disease.
 - (2) Conditions favoring the disease.
 - (3) Remedy.

PRACTICE WORK IN PLANT PROPAGATION.

1. Propagate late in spring grapes and dewberries by layering, or observe plants that have been so propagated.
2. By use of onions or lilies, show the formation of bulbs.
3. Divide potatoes and sweet potatoes, and plant.

4. Dig up Johnson grass, asparagus, and canna to show crowns.
5. Divide canna crown into a number of pieces and plant.
6. Examine "tip" onions or tiger lilies for bulblets.
7. Examine hyacinths, gladiolus, narcissus, etc.
8. Make hotbed to grow cuttings, unless hothouse is available.
9. Make greenwood stem cuttings of geraniums, coleus, chrysanthemums, roses, tomatoes, Wandering Jew, oleander, alternanthera lantana, salvia, stevia, heliotrope, artillery plant, sweet alyssum, etc. Propagate for landscape work and for sale. Pot and keep in cold frames till ready to sell or plant.
10. Make leaf cuttings of begonias, Bryophyllum, iris, lily, cactus, etc.
11. Make hardwood cuttings of grapes, figs, roses, privet, willow, cottonwood, pecan, bridal wreath, wisteria, etc. Store in moist earth bottom end up for three weeks.
12. Make root cuttings of blackberry, horseradish, etc.
13. Bud peach seedlings by shield-budding, and pecan seedlings by chip-, patch-, and ring-budding.
14. Graft by whip-grafting, apples, plums, pears, etc.
15. Graft by cleft-grafting, apples, pears, pecans, etc.
16. Study germination of seeds. Observe differences in methods of germination or how plant gets out of seed coats. Determine per cent of germination. Plant twenty of each of the following between moist blotters, or in folds of cheese cloth and cover with moist sand: lima beans, navy beans, beets, salsify, garden pea, okra, watermelon, squash, onion, radish, parsnips, field corn, date, etc. Make drawing of each before planting and leave space for a drawing after sprouting. Learn to distinguish all seeds studied.

REFERENCE MATERIAL IN PLANT PROPAGATION.

I. Minimum:

1. Bailey: The Nursery Book (Macmillan Co., Dallas), \$1.50.
2. Farmers' Bulletin No. 157: Propagation Plants (U. S. Dept. of Agriculture).

II. Other books desirable:

1. Bailey: Manual of Gardening (Macmillan Co., Dallas), \$2.00.
2. Fuller: Plant Propagation (Orange Judd Co., New York), \$1.50.

VEGETABLE GARDENING.

1. Locating the home garden:
 - a. Distance from house.
 - b. Slope of land.
 - c. Character of the soil and subsoil.
 - d. Exposure.
 - e. Drainage.
2. Planning the garden:
 - a. Plans for back lot gardens in towns and cities.
 - b. Plans for half-acre vegetable gardens (*Fundamentals of Farming and Farm Life*, Kyle & Ellis, page 207).
3. Truck farming and market gardening districts in the United States.
4. Areas devoted to each in Texas.
5. Factors determining location of districts:
 - a. Marketing facilities.
 - b. Labor problems.
 - c. Soil and climate.
6. Importance of truck farming.
7. Importance of abundance of moisture in growing truck crops.
8. Seed beds.
 - a. Temperature in which hotbeds are profitable.
 - b. Construction and use of hotbeds:
 - (1) Manure hotbeds.
 - (2) Pipe heated hotbeds.
 - (3) Flue heated hotbeds.
 - c. Construction and use of cold frames.
 - (1) For growing half hardy plants.
 - (2) For hardening off plants from hotbeds before transplanting.
 - (3) For starting plants for early spring planting.
 - d. Cost of constructing cold frames.
 - e. Care and management of frames.
 - f. Location of hotbeds and cold frames with reference to the house and to the garden.
9. The soil and its treatment:
 - a. Soils best adapted to gardening and trucking; character of surface and subsoil.
 - b. Time and depth of plowing.
 - c. Pulverizing and fining.
 - d. Firming the soil.
 - e. Manuring and fertilizing.
 - (1) Value of barnyard manures.
 - (2) Kind of manure best adapted to vegetable growing.
 - (3) Composting manure for trucking and gardening.
 - (4) Advisability of green manure in truck gardening.
 - (5) Commercial fertilizers used in truck growing.
 - (a) Elements needed by crops.
 - (b) Form in which they should be applied.

- (6) Time and method of applying manures and fertilizers.
- (7) Danger of applying fresh manures.
- 10. Seeds and seeding.
 - a. Sources of supply of seeds.
 - b. Longevity of seed.
 - c. Preservation of seed.
 - d. Testing before planting.
 - e. Importance of strong germination.
 - f. Seeding.
 - (1) Time of seeding in hotbeds and cold frames.
 - (2) Time of seeding in the garden proper.
 - (3) Rate and depth of seeding.
- 11. General culture method.
 - a. Implements and tools used in cultivating truck crops.
 - b. Purposes of cultivation.
 - c. Necessity of thorough, careful cultivation.
 - d. Irrigation.
 - e. Double cropping.
 - f. Transplanting.
 - g. Importance of crop rotation.
 - h. Protection from frost and freezing.
- 12. Enemies of garden and truck crops:
 - a. Weeds.
 - (1) List of most troublesome weeds.
 - (2) Methods of control.
 - b. Insect pests:
 - (1) List of insects injurious to vegetable crops.
 - (2) Methods of control.
 - c. Fungus and bacterial diseases.
 - (1) Most common disease of garden crops.
 - (2) Preventive and remedial measures.
- 13. Harvesting, marketing and storing:
 - a. Harvesting.
 - (1) Time.
 - (2) Method.
 - (3) Care.
 - b. Marketing.
 - (1) Local marketing.
 - (a) Harvesting for local marketing.
 - (b) Packing for home market.
 - (c) Transportation.
 - (d) Wholesale or retail markets.
 - (2) Marketing at a distance.
 - (a) Crates, barrels, etc., for packing.
 - (b) Packing and shipping.
 - (1) Gardening for packing.
 - (2) Importance of snug packing.
 - (3) Neatness and attractiveness essential factors.
 - (4) Precooling.
 - (5) Icing refrigerator cars for shipment.

- (3) Basis of good marketing.
 - (a) Good and seasonable product.
 - (b) Uniform grades in the marketed product.
 - (c) Good packing.
 - (d) Attractive packages.
 - (e) Honesty on part of both grower and seller.
 - c. Storing.
 - (1) Essentials to be observed in storing.
 - (2) Storing in cellars and pits.
 - (3) Cold storage houses.
 - (4) Advisability of storing.
 - (5) Danger of storing.
- 14. Classification of vegetable crops.
 - a. Root crops: radish, beet, carrot, turnip, rutabaga, parsnip, salify, horseradish, sweet potato.
 - b. Tuber crops: Irish potato.
 - c. Bulb crops: onion, Welsh onion, leek, garlic, cive.
 - d. Cole crops: cabbage, cauliflower, kale, Brussels sprouts, kohlrabi.
 - e. Pot-herb crops: spinach, chard, mustard, dandelion.
 - f. Salad crops: lettuce, endive, chicory, cress, corn salad, parsley, celery, celeriac.
 - g. Pulse crops: peas and beans.
 - h. Solanaceous crops: potato, tomato, egg plant, pepper, husk tomato.
 - i. Cucurbitous or vine crops: cucumber, muskmelon, watermelon, pumpkin, squash, pie melon.
 - j. Miscellaneous annuals: sweet corn, okra, martynia.
 - k. Perennial crops: asparagus, rhubarb, dock, sorrel, artichoke, sea kale.
- 15. Outline for the study of each vegetable separately.
 - a. Native home.
 - b. Early history and distribution.
 - c. Early characteristics.
 - d. Introduction into United States.
 - e. Improvements
 - f. Types and varieties.
 - g. Present distribution.
 - i. Brief study of the plant.
 - (1) Leaves: size; arrangement; number.
 - (2) Stem: structure; size; height.
 - (3) Flower: number and arrangement of parts.
 - (4) Root: kind; depth; spread.
 - (5) Length of life.
 - (6) Dioecious or monoecious.
 - (7) Methods of reproduction.
 - (8) Part of plant used for table purposes.
 - j. Soils best adapted to growth.
 - k. Fertilizers and manures.
 - (1) Kind to use.
 - (2) Time to apply.

- l. Preparation of the seed bed.
- m. Producing plants for transplanting.
- n. Planting in seed beds proper.
- o. Transplanting.
 - (1) Fundamental principles of transplanting.
 - (2) Special devices and special machinery.
- p. Kind and amount of cultivation.
- q. Insects and diseases injurious to the crop.
- r. Insecticides and fungicides as means of control.
 - (1) Spray mixtures most effective for each.
 - (2) Time to apply.
 - (3) Rate of applying.
 - (4) Methods of applying.
 - (5) Dangers from using spray mixtures.
- s. Harvesting, packing, storing and marketing.
- t. Utilization of the crop.

(Time will not be available to apply the outline to all vegetables listed above. Select according to time available and the local importance of the crop.)

PRACTICE WORK IN VEGETABLE GARDENING.

1. Construct hotbeds and cold frames. Instructions for the making of hotbeds and cold frames may be found in almost any text on gardening or truck growing. Have the students select locations for constructing both, and make them not only large enough to supply the school garden with such plants for transplanting as may be needed, but large enough to supply the community with plants and with some of the half hardy vegetables ordinarily grown in cold frames.

2. Have each student keep a window box and grow such plants for transplanting as are ordinarily grown indoors in farm houses. Compare the efficiency of the window box with hotbeds.

3. Take one-sixth or one-fourth acre of the school farm and plan and develop an ideal home vegetable garden, paying special attention to plan and arrangement, crops to be grown, succession of crops, etc.

4. Visit a truck farm if one is within reach of the school. Observe the character and fertility of the soil, the drainage, general cultivation, special cultivation, etc. Ask questions regarding the rotation practiced, fertilizers used, spraying practices, harvesting, packing, storing and marketing.

5. Take a trip to a wholesale house if possible, or to a number of retail houses if the former cannot be done. Observe the different truck products, noting the following points: (1) where grown; (2) their condition; (3) the grade; (4) care in packing; (5) neatness of package; (6) selling price.

6. Procure seeds of the truck crops commonly grown in your locality and test the germination. Ask gardeners and truck growers to furnish you with samples of the seed they have for planting. Make careful tests of these and give the information to the parties furnishing the seeds. Procure samples of seeds from dealers in your community and test the germination.

7. Procure crates suitable for shipping such truck crops as are grown on the school farm, and pack as you would for shipment. Give enough practice in gardening and packing to make the students fairly proficient in putting up a neat, snug, uniform package.

8. Procure specimens of diseased plants for study in the laboratory. Study the cause of the diseases, method of spread, economical importance, and control. Students should have access to a high power microscope in this work and should make drawings of the diseases in different stages. They should learn to recognize a few of the most common diseases where they are seen under field conditions.

9. Make a careful study of one or more spray machines and test the efficiency of each, using different nozzles for spraying. Make spray mixtures ordinarily used for common insect and fungus pests. Apply with the nozzle found most efficient for the particular spray.

10. Visit an implement dealer and study the truck implements and tools that he has in stock. If he will give a demonstration of their work on the school farm, have him do so. If he cannot do this, take the class to a truck farm and have them observe the work of the different machinery used.

11. Provide individual plots about 12x40 feet. Require students to plan arrangement and choice of crops and report for approval of teacher. Use seed catalogues for getting variety of crop. Require students to do all work on the plot after plowing and harrowing. Grade students on appearance and condition of plot. Require extensive variety of crops for each.

12. Have grown in the garden all the different crops studied that students may observe habits of growth, appearance, etc.

REFERENCE MATERIAL IN VEGETABLE GARDENING.

I. Minimum.

1. Bailey: Principles of Vegetable Gardening (Macmillan Co., Dallas), \$1.50.
2. Corbett: Garden Farming (Ginn & Co., Dallas), \$2.00.
3. Watts: Vegetable Gardening (Orange Judd Co., New York), \$1.75.
4. Bulletin No. 3: School and Home Gardens (State Normal School, Cheney, Wash.).
5. Bulletin No. 252: Some Types of Children's Garden Work (U. S. Dept. of Agriculture).
6. Bulletin No. 160: School Gardens (U. S. Dept. of Agriculture).
7. Bulletin No. 204: School Gardening and Nature Study in English Rural Schools and in London (U. S. Dept. of Agriculture).
8. Bulletin No. 10: The Home Vegetable Gardening (Virginia Truck Experiment Station, Norfolk).
9. Circular No. 3: Truck Farming (Texas Experiment Station, College Station).

10. Circular No. 33: Hotbeds and Cold Frames; Their Preparation and Management (Missouri Experiment Station, Columbia).
11. Circular No. 46: Suggestions for Garden Work in California Schools (University of California, Berkeley).
12. Circular No. 62: The School Garden in the Course of Study (University of California, Berkeley).
13. Farmers' Bulletin No. 460: Frames as a Factor in Truck Growing (U. S. Dept. of Agriculture).
14. Farmers' Bulletin No. 33: Hotbeds and Cold Frames (U. S. Dept. of Agriculture).
15. Farmers' Bulletin No. 255: The Home Vegetable Garden (U. S. Dept. of Agriculture).
16. Farmers' Bulletin No. 218: The School Garden (U. S. Dept. of Agriculture).

II. Other books desirable:

1. Bailey: Forcing Book (Macmillan Co., Dallas), \$1.25.
2. Bailey: Garden Making (Macmillan Co., Dallas), \$1.50.
3. Brill: Farm Gardening and Seed Growing (Orange Judd Co., New York), \$1.00.
4. Davis: Up-to-date Truck Growing in the South (Cultivation Pub. Co., Atlanta), \$1.00.
5. Fraser: The Tomato (Orange Judd Co., New York), 75c.
6. Greiner: New Onion Culture (Orange Judd Co., New York), 50c.
7. Hemenway: How to Make School Gardens (Doubleday, Page & Co., Garden City, N. Y.), \$1.00.
8. Landreth: Market Gardening and Farm Notes (Orange Judd Co., New York), \$1.00.
9. Meier: School and Home Garden (Ginn & Co., Dallas), 80c.
10. Oemler: Truck Farming in the South (Orange Judd Co., New York), \$1.00.
12. Shaw: Market and Kitchen Gardening (Van Nostrand, New York), \$1.40.
13. Tracy: Tomato Culture (Orange Judd Co., New York), 50c.
14. Williams: Gardens and Their Meaning (Ginn & Co., Dallas), \$1.00.

ANIMAL HUSBANDRY.

I. Live stock Industry.

1. Importance of animal husbandry.
 - (1) Use for food, clothing, labor, etc.
 - (2) Extent of the industry.
 - (3) Live stock industry in Texas.
2. Influence of stock farming on soil fertility.
3. Live stock as an investment.
4. Fascination of stock raising.

II. Improvement of animals.

1. Origin of domesticated animals.
 - (1) Horse.
 - (2) Cow.
 - (3) Sheep.
 - (4) Pig.
 - (5) Goat, etc.
2. How they came to be domesticated.
3. Need of improvement in domesticated animals.
4. Effect of natural selection.
5. Variability and unit characters.
6. How characters are transmitted.
7. Law of ancestral heredity.
8. Heredity and environment.
9. Artificial selection.
10. Origin of "pure bred."
11. Significance of pedigrees.
12. Examples of striking improvement.
13. Sports.

III. Animal nutrition.

1. Need of food.
 - (1) Supply heat: body's loss of heat; source of heat when food is not available; result.
 - (2) Repair body: need of repair; kind of food necessary.
 - (3) Produce growth: method of growth.
 - (4) Supply energy to do work: source of all energy; potential and kinetic energy; body a machine; animals differ in efficiency of machine; compare steam engine; constant need of energy; result when food is not supplied.
 - (5) Produce fatty tissue: use; importance.
 - (6) Special products: milk, eggs, feathers, wool, etc.; no element in product not in food; kinds of food needed.

2. Composition of feeds.
 - (1) Water: variations; use; importance and dangers; method of determination.
 - (2) Ash: variation in amount; minerals most abundant; use by animal; method of determination.
 - (3) Protein: variation in amount; uses; examples of protein.
 - (4) Carbohydrates: prevalence; forms; uses; importance.
 - (5) Fats: prevalence; energy value; uses; feeds with high fat content.
3. Kinds of feeds: nitrogenous; carbonaceous; concentrates; roughage; forage; by-product feeds; condimentals.
4. Process of nutrition.
 - (1) Prehension and mastication: compare cattle, horses, fowls; teeth.
 - (2) Digestion: principles of fermentation; organized and unorganized ferments; digestive glands, juices, enzymes; location and function of each; comparison of digestive tracts of cattle, horses, fowls.
 - (3) Absorption: methods; conditions; location.
 - (4) Circulation: course of blood; lymph; course of food.
 - (5) Assimilation and oxidation: products; by-products; storage, etc.
 - (6) Excretion and elimination: channels.
5. Digestibility of feeds: how determined; how influenced by palatableness, quantity, preparation, stage of maturity, regularity and frequency of feeding and watering; combination of foods; supply of salt; character of animals.
6. Feeding: rations; balanced ration; nutritive ratio; maintenance ration; production ration; feeding standards; importance of comfort of animals; method of computing rations; problems.

IV. Horses.

1. Origin.
2. History.
3. Early distribution.
4. Present distribution.
5. Economic importance in the United States.
6. Number of horses in the United States.
7. Number of horses in the United States in 1910; 1900; 1890.
8. Average value today as compared with the average value in 1910; 1900; 1890.
9. Types of horses.
 - a. Arabian horse.
 - b. Draft.

- (a) The French group,—Percheron, Norman, etc.
 - (b) The Belgian.
 - (c) The British group: Clydesdale; Shire; Suffolk.
 - c. Coach: Hackney; French coach; German coach.
 - d. Light horses: American saddle horse; thoroughbred; roadster; pacer; trotter.
 - e. Ponies: Shetland; Welsh; Exmoor; Indian ponies, mustangs or bronchos.
- 10. Study the principal breeds in Texas according to the following outline:
 - a. Origin and early history.
 - b. Development of the breed.
 - c. Characteristics peculiar to the breed: size; color; general conformation; durability; temperament.
 - d. Distribution and adaptation.
 - e. Popularity.
 - f. Comparison with other breeds of the same type.
 - g. Noted individuals in the breed.
 - h. Breed associations.
- 11. Care and management.
 - a. Training of the horse.
 - b. Feeding.
 - (1) Principles and practice of feeding horses.
 - (2) Ration for work horse.
 - (3) Ration for brood mares.
 - (4) Ration for fleshing horses for market.
 - (5) Rations for young stock.
 - (6) Value of different rations.
 - c. General care of work horses during work and rest season.
 - d. Care of stallion in and out of season.
 - e. Care of brood mares and foals.
 - f. Care of new-born foals.
 - g. Care of colts and fillies.
 - h. Fitting for sale.
 - i. Fitting for show and showing.
- 12. Hygiene.
 - a. Size of stalls.
 - b. Care of stalls: bedding, cleaning, etc.
- 13. Unsoundnesses and their remedy: curbs, side-bones, spavin, ring-bones, splints, heaves, defective eyes, etc.
- 14. Common diseases of horses: cause of; symptoms; prevention; treatment.
- 15. Dentition: how to tell the age of horses.
- 16. Some famous horses.

(The above outline will suggest method of studying mules.)

V. Hogs.

1. Origin and history.
2. Early improvement.
3. Importance of the hog on farm in the United States.
4. Area of hog production as related to area of corn production.
5. Hog marketing centers.
6. Economic importance of hogs in the United States.
7. Price of hogs as affected by the corn crop and by supply of hogs.
8. Types of hogs.
 - a. Lard type.
 - (1) Major breeds of the fat or lard type; Poland-China; Berkshire; Chester White; Duroc-Jersey.
 - (2) Minor breeds of the lard type: Cheshire; Victoria; Small Yorkshire; Essex; Suffolk.
 - b. Bacon type: Tamworth; Yorkshire; Hampshire or Thin Rind.
 (The Hampshire is usually classed as a bacon type of hog, but its conformation would probably place it in the minor breeds of the fat type.)
9. Classification of breeds according to size.
 - a. Small breeds: Small Yorkshire; Suffolk; Essex; Victoria.
 - b. Medium breeds: Duroc-Jersey; Poland-China; Berkshire; Hampshire.
 - c. Large breeds: Chester White, Tamworth; Large Yorkshire.
10. Outline for study of each breed separately.
 - a. Origin and history.
 - b. Early improvement.
 - c. Early importations to the United States.
 - d. Early breeders.
 - e. Present-day breeders.
 - f. Distribution and adaptation.
 - g. Characteristics of the breed: color; size; conformation; grazing qualities; fattening qualities; prolificacy; precocity.
 - h. Popularity.
 - i. Breed association.
11. Care and management of hogs.
 - a. Breeding.
 - (1) Breeding pure: danger of inbreeding.
 - (2) Cross breeding: purpose and advantages.
 - (3) Grade breeding: advantage to man with small capital.
 - b. Feeding.
 - (1) The feeding floor.

- (a) Construction.
 - (b) Cleanliness.
 - (c) Size as related to the number of hogs using it.
 - (2) Methods of feeding.
 - (a) Placing enough on floor for several days.
 - (b) Feeding just enough for one meal.
 - (3) Feed rations.
 - (a) For sows suckling pigs.
 - (b) For young pigs.
 - (c) For pigs at weaning time.
 - (d) For sows and boars.
 - (f) For fattening hogs.
 - (4) Age to begin feeding for market.
 - (a) Advantages for feeding off early.
 - (b) Reasons for late feeding.
 - (c) The water supply.
 - (1) Necessity of pure, clean, fresh water.
 - (2) Danger of hog wallows.
 - c. Housing conditions.
 - (1) Necessity of hog houses.
 - (2) Construction and cost.
 - (3) Advantages of portable houses.
 - d. Care of pregnant sows.
 - e. Care of sows at weaning time.
 - f. Breeding pens and crates.
 - g. Dipping hogs.
 - (1) Purpose.
 - (2) Method.
 - (3) Kind of dips.
 - i. Best age of castrating and spaying.
12. Market grades of hogs (Chicago market).
- a. Choice to prime heavy.
 - b. Medium to good heavy.
 - c. Butcher weights.
 - d. Good to prime mixed.
 - e. Rough heavy packing.
 - f. Poor to prime pigs.
 - g. Straight to heavy packing.
 - h. Selected bacons.
 - i. Stags.
 - j. Boars.
13. Care of show stock.
14. Diseases of swine: cholera; tuberculosis; pneumonia; scours; thumps; mange; paralysis; worms.
15. Study the most common diseases of hogs according to the following outline:
- (1) Cause of disease.
 - (2) Contagious or infectious.

- (3) How transmitted.
- (4) Preventive measures.
- (5) Treatment.
- 16. General swine sanitation.
 - a. General cleanliness of feed, water, pens, etc.
 - b. Disinfection in case of disease.
 - c. An abundance of sunlight in pens and houses.
 - d. Burning carcasses of diseased hogs.
 - e. Dipping for lice, mange, etc.

VI. Sheep.

- 1. Origin and history.
- 2. Early improvements.
- 3. Areas of mutton and wool production in the United States.
- 4. Importance of these industries.
- 5. Conditions best adapted to mutton and wool production.
- 6. Types of sheep.
 - a. Merino or fine-wool type.
 - (a) American Merino.
 - (b) Delaine Merino.
 - (c) French Merino or Rambouillet.
 - b. Mutton type.
 - (1) Middle-wool: Southdown; Shropshire; Hampshire Down; Oxford Down; Dorset Horn; Cheviot; Tunis.
 - (2) Long-wool: Leicester; Lincoln; Cotswold; Black-faced Highland.
- 7. Outline for study of each breed separately.
 - a. Native home.
 - b. Breeding and ancestry.
 - c. Introduction to America.
 - d. Distribution and adaptation.
 - e. Characteristics.
 - (1) General appearance.
 - (2) Size.
 - (3) Color.
 - (4) Conformation.
 - (5) Length of wool and grade.
 - (6) Grade of mutton produced.
 - (7) Grazing qualities.
 - (8) Feeding qualities.
 - f. Popularity.
 - g. Breed associations.
- 8. Care and management of sheep.
 - a. Breeding.
 - (1) Breeding and improvement in herd.
 - (2) Grading up herd by breeding.
 - (3) Crossing.
 - b. Feeding.
 - (1) Improved methods of feeding sheep.
 - (2) Time to begin feeding lambs for market.

- (3) Ration for lambs for early market.
 - (4) Ration for wethers for fall market.
 - (5) Feeding ewes and rams.
 - (6) Ration for lambs to be used for breeding purposes.
 - (7) Facilities for feeding on the range.
 - (8) Facilities for feeding on the farm.
 - c. Housing sheep.
 - (1) Necessity for housing conditions.
 - (2) Kinds of houses.
 - (3) Effect of rough weather on the herd.
 - d. Care of ewes for lambing.
 - e. Care of ewes and lambs at lambing period.
 - f. Production of hothouse lambs.
 - g. Castrating buck lambs for feeding.
9. Market-grades of sheep.
 - a. Mutton sheep:
 - (1) Lambs: prime; choice; good; fair; culls.
 - (2) Yearlings: prime; choice; good.
 - (3) Wethers: prime; choice; good; common.
 - (4) Ewes: prime; choice; good; fair; culls.
 - (5) Bucks and stags: choice; good; common.
 - b. Feeder sheep.
 - (1) Lambs: fancy selected; choice; good; fair; common.
 - (2) Yearlings: choice; good; fair.
 - (3) Wether: choice; good; fair; common.
 - (4) Ewes: choice; good; fair; common.
10. Care of show stock.
11. Shearing sheep.
 - a. Methods and machines for shearing.
 - b. Season for shearing.
 - c. Shearing wether lambs before fattening.
12. Diseases of sheep: scabies; foot rot; grub; bloat, etc.
(Study each of the common diseases according to the outline given under hogs.)
13. General sanitation.
 - a. Dips and dipping for parasites.
 - b. Sanitary conditions around watering places, barns, etc.

VII. Goats.

1. Breeds of goats.
 - a. Fleece breeds: Angora; Cashmere.
 - b. Milk breeds: Maltese; Toggenburg; Appenzell; Saanen; Schwarzthal; Langesalzer; Nubian.
2. The goat as a renovator of brush land.
(Use outline for sheep in the study of goat.)

VIII. Cattle.

A. Beef industry.

1. Importance: statistics on production and on prices; areas devoted to the industry in United States and in Texas; factors influencing location of areas; trend of beef industry.
2. Types and breeds.
 - (1) Major breeds of beef cattle: Shorthorn; Aberdeen-Angus; Hereford; Galloway.
 - (2) Minor breeds of beef cattle: Red Polled; Devon; Sussex; West Highland; Polled-Durham.
 - (3) Dual purpose breeds: Red Polled; Devon; Brown Swiss.
3. Outline for studying each breed separately.
 - (1) Origin and history.
 - a. Composition of the breed.
 - b. Early records.
 - c. First prominent breeders.
 - d. Date of coming into prominence in the United States.
 - (2) Breed characteristics.
 - a. Hardiness.
 - b. Temperament.
 - c. Color.
 - d. Size.
 - e. Weight.
 - f. Conformation.
 - g. Beef producing or milking qualities.
 - h. Special records as a beef or dairy breed.
 - (3) Distribution in the United States.
 - (4) Adaptation of breed.
 - (5) Chief defects.
 - (6) Popularity as a beef or dairy breed.
 - (7) Principal breeders.
4. Care and management of cattle.
 - (1) Breeding.
 - a. General principles of breeding.
 - b. Age at which heifers should be bred.
 - c. Best season of year for calving.
 - (2) Feeding.
 - a. Calculation of standard rations.
 - (a) Maintenance rations.
 - (b) Rations for fattening beef cattle.
 - (c) Rations for calves and growing young stock.
 - b. Production of baby beef.
 - (a) Advantages.
 - (b) Age of selling.
 - c. Feeding one, two, and three-year-old steers.

- (a) Advantages.
 - (b) Disadvantages.
 - d. Equipment for summer feeding.
 - e. Equipment for winter feeding.
 - (3) Shelter and protection.
 - (4) Care of bulls.
 - a. Feeding.
 - b. Exercising.
 - c. Ringing: age to ring.
 - d. Best methods of handling to prevent accidents.
 - (5) Care of cows; feeding; exercising; exposure.
 - (6) Care of calves.
 - a. Rations for calves before weaning.
 - (a) Dairy calf.
 - (b) Beef calf.
 - b. Age to wean.
 - c. Methods of weaning.
 - d. Rations for growing calf.
 - e. Castration of bull calves: age; method; precautions.
 - f. Dehorning: necessity; methods.
 - (7) Dehorning cattle other than calves.
 - a. Methods of dehorning.
 - (a) Devices for holding cattle.
 - (b) Manner of removing horns.
 - (c) Place to make the cut.
 - b. Treatment after dehorning.
 - c. Advantages.
5. Pure bred compared with scrubs as to:
- (1) Ease of fattening.
 - (2) Cost of putting on fat.
 - (3) Milk production.
 - (4) Market value.
 - (5) Hardiness.
6. Grading up herd.
- (1) Procure pure bred sire.
 - (2) Select best females from herd for breeding purposes.
 - (3) Continue to breed pure bred sires to the best grade heifers until the strain is practically pure.
7. Fitting and showing.
- (1) Feeding.
 - (2) Trimming.
 - a. Care of coat.
 - b. Care of hoofs and horns.
 - (3) Showing.
 - a. Showing animals to best advantage.
 - b. Attitude of exhibitor toward judge.

8. Market classification of beef cattle.

- (1) Beef cattle.
- (2) Western cattle.
- (3) Butcher cattle.
- (4) Canners and cutters.
- (5) Stockers and feeders.
- (6) Export cattle.
- (7) Shipping cattle.
- (8) Baby beef.
- (9) Milkers and springers.

9. Grades of beef cattle: prime; choice; good; fair to medium; poor.

10. Marketing beef cattle.

- (1) Local marketing as compared with shipping to market.
- (2) Time to market.
- (3) Marketing suggestions.
 - a. Every feeder should have a daily paper quoting prices.
 - b. He should understand classes of stock thoroughly.
 - c. Ship on a rising market always.
 - d. Procure the best shipping facilities possible.
 - e. Provide plenty of feed if trip is long.
 - f. Secure a reliable commission firm to deal with, and stick to them.

11. Meat on the farm.

- (1) Preparation for slaughter: keep off feed 24 to 36 hours before killing.
 - a. Decomposition of food in the stomach very rapid after killing.
 - b. Gives bad color to carcass.
- (2) Age to kill for veal, baby beef, beef.
- (3) Best method of killing, sticking, skinning, removing offal, etc.
- (4) Clean, sanitary methods of handling meat.
- (5) Precautions in killing for meat:
 - a. Kill only healthy animals.
 - b. Kill no animal losing in flesh.
 - c. Don't kill animals for home use or for market from a diseased herd.
 - d. Never kill a badly bruised animal unless immediately after the accident.

B. Dairy industry (see pages 65-68).

C. Poultry (see pages 69-73).

PRACTICE WORK IN ANIMAL HUSBANDRY.

I. Practice work on horses.

1. Have students study the parts and points of the horse from charts and drawings taken from books and bulletins before giving him any work on the animal itself. This study will enable him to interpret the score card more intelligently.
2. Using charts, photos, drawings and lantern slides, if available, locate the more common unsoundnesses and faults in horses. Drill on these until the student knows where to look, what to look for and how to detect them. Note all unsoundnesses in the stock to be judged.
3. Study of score card.
 - a. Purpose of study.
 - (1) To enable the student to see the various parts of animals in logical order.
 - (2) To enable the student to see the various parts in detail and secure an idea of the relative importance of each.
 - (3) To create an ideal in the student's mind.
 - (4) To aid in live stock judging.
 - b. How to study.
 - (1) Learn the location of points.
 - (2) Learn different uses of animal and classify according to use.
 - (3) Fix an ideal for the class or type and learn to recognize departures from that ideal.
4. Score a few animals and compare scores.
5. Judging.

After scoring a number of animals, compare several animals of the same kind, class and age. Keep your ideal of the class in mind and compare points, balance your comparisons, and place the animals according to their superiority. Judging should continue throughout the year whenever there is opportunity.
6. Show-ring judging for draft horses.
 - a. Examination when moving:
 - (1) Moving away at a walk.
 - (2) Moving back at a walk.
 - (3) Moving away at a trot.
 - (4) Moving back at a trot.
 - (5) Moving past at a walk.
 - (6) Moving past at a trot.
 - (7) Note the following points:
 - (a) Whether feet are lifted with a snap, indicating flexing of joints.
 - (b) Whether action is straight, i. e., carried forward in a straight line.
 - (c) Flexing of the hocks.

- (d) Distance between hocks when moving.
- (e) Whether there is "spraddling" due to wide motion or interfering due to narrow motion.
- (f) Whether there is rolling of body, due to poor flexing of joints.
- (g) Whether there is any "winging" or lateral motion of fore limbs.
- (h) Length of stride.
- (i) Whether there is undue expenditure of energy or shortening of stride by high action.
- b. Examination when standing.
 - (1) Examine the following principal points affecting utility and market value: size; soundness; conformation; quality; temperament; style.
- 7. All other types of horses.

Further judging will be much easier for the student. The parts of all horses are the same, and indications of quality and conformation, and methods of making observations and examinations are the same.
- 8. Showing horses.
 - a. How to move and stand a horse before the judge.
 - b. Cleaning and grooming for the show ring.
- 9. Practical points in horsemanship.
 - a. Making rope halters. (Rainy day exercises. Have students furnish rope and keep their halters.)
 - b. Breaking horses to work. Time to begin and best methods of handling.

II. Practice work on cattle and dairying:

1, 2, 3, 4 and 5 should correspond to laboratory exercises 1, 2, 3, 4 and 5, respectively, under the outline for horses, using beef and dairy cattle for the study. Visit as many herds of beef and dairy cattle as possible in this study and observe methods of handling the herd.

6. Visit feeding pens, barns and sheds where beef cattle are kept. Compare each in waste, efficiency, convenience and results. Get data regarding the amount of feed consumed, gains made, loss of manure, etc., and compare the relative efficiency of the different system of feeding. Note the following points in your visits: Are cattle exposed to cold and rain? Do they have to lie on cold, wet ground? Do they go through the mud to get water? Do they stand in mud during the day? Discuss these points with the class and their relation to laying on fat.

7. Have students select a home project in feeding beef cattle. Interest one in producing baby beef; another in fattening yearlings; another in feeding two-year-olds, etc. Let each student keep a record of the weight of the animal when he began feeding; the daily ration; care and management during experiment; gains made; cost of labor;

cost of feed; profit, etc. Encourage each boy, if it is at all possible for him to do so, to try a feeding experiment.

8. If there is a slaughtering house or packing center near enough, take the class to visit it. Observe the methods of handling the carcasses, the sanitary conditions, etc. Visit the meat market and study the different cuts of meat. Learn the names of these and their relative prices.

9. Encourage students to watch for cattle trains that pass through the nearest railroad points, that they may observe the breeds, types, grades, condition for market, shipping conditions, etc. If the animals have not been dehorned, note whether they have injured each other with their horns.

10. Procure some calves from three to seven days old. Clip the hair from the horn buttons, wash clean with soap and warm water, and dry thoroughly. Wrap one end of a stick of caustic soda or caustic potash with paper to prevent injury to the hands while handling. Moisten the uncovered end and rub it on the horn buttons, first on one and then the other, two or three times each, allowing the caustic to dry after each application. Be careful that the caustic does not touch any of the skin surrounding the horn button. Be careful also not to have the end of the stick too wet, as it might run; it removes the skin wherever it comes in contact with it. Keep the calf in out of the rain for a few days after treatment, as rain would cause the caustic to spread.

11. Ask a farmer, dairyman, or cattleman to give a demonstration to the class on dehorning older cattle. Take the students to this farm and have them observe carefully the method of handling the cattle; the device for holding them; the instruments for removing the horns; the place of making the cut; treatment after dehorning, etc. If possible, have work done with both clippers and saws. At least try to have the different instruments commonly used for dehorning, so that the class may see them. Discuss the relative merits of each.

12. Visit dairy farms and study the herd and its care and handling. Make a careful study of the barn, noting the points in the outline under dairy barns. Make complete notes on sanitary conditions, conveniences, etc. Ask the herdsman for rations, and get all the information regarding the cows possible. If individual records are kept, ask for them. Discuss all observations thoroughly in class.

13. Interest a few boys in testing the cows in their herd. Have them take three or four cows and keep a careful feeding record, as well as an accurate record of the amount of milk produced and the per cent of butter fat it contained. Compare the relative efficiency of the cows tested.

14. Have students bring samples of milk from the herd, and samples from the cows they think the best and the poorest. Test these in the laboratory. If there are different breeds of dairy cattle in the community, test the breeds for butter fat.

15. Provide samples of skim milk, whole milk, and watered milk. Using the Babcock test and the lactometer, have students identify each. Use more than one sample of each. It may require several laboratory periods for the students to learn to handle the apparatus with

any degree of proficiency. Give them several exercises, and do not work too rapidly.

16. The directions for making the tuberculin test may be found in any text on dairying and in many of the experiment-station reports and government bulletins. The students should be taught how to make the test accurately, and the importance of testing the herd.

17. Encourage the patrons to send in samples of milk to be tested for butter fat by the students.

18. Have students study the construction and use of the cream separator. Test the effect of speed on the cream separated.

19. Test acidity of milk or cream by the Farrington's alkaline test: "Dissolve five of Farrington's tablets in enough water to make solution 97 c.c. Mix well, and measure out 17.6 c.c. of the milk or cream to be tested, and add the alkali solution until the characteristic pink color remains. The number of c.c. of alkali solution required to produce this result indicates the number of hundredths per cent acid, since one c.c. of alkali neutralizes .01 per cent of acid when 17.6 c.c. of milk are used. Therefore the number of c.c. neutralizer used divided by 100 equals per cent of acid. For instance: If 50 c.c. solution be used the acidity of the milk in question is .5 per cent. The Farrington tablets contain alkali equal to 3.8 c.c. of tenth normal solution, and also the color indicator."

20. Give experience in ripening cream by use of starter and by use of natural means.

21. Give practice in butter making.

22. Have students make cottage cheese.

23. Give practice in making ice cream.

24. Test for formaldehyde:

"Add one drop of formaldehyde to one-half pint of milk and shake thoroughly. Obtain by means of a pipette, 17.6 c.c. or any convenient amount of the milk, and place in Babcock test bottle. Add a similar amount of sulphuric acid and allow to stand quietly for five minutes. Note color line at junction of acid and milk, which should be a distinct purple or violet, indicating the presence of formaldehyde. Repeat the experiment, using concentrated hydrochloric acid. Also add a few drops of ferric chloride to aid the color reaction. Formaldehyde is a colorless, volatile liquid, chemically intermediate between methyl alcohol and formic acid. When consumed with milk, it produces various intestinal disturbances; and, if present in excessive amounts, produces poisoning."

25. Test for oleomargarine:

"Place 5 grams, or any convenient amount, of oleomargarine in a small dish and apply flame. Place in another dish a similar quantity of butter. Note the difference in the manner in which they melt. The oleomargarine sputters like grease in a frying-pan on account of the excessive amount of water present. It does not foam, however, as much as the butter. The butter melts quietly and foams a great deal. Note, too, the odor of lard in oleomargarine. Score a sample of each for flavor, texture, grain and body."

26. Bacteriological tests may be made to show contamination from

barn air, coat of animal, manure, utensils, etc. (Teacher should prepare agar plates to be used.)

27. Practice may be given in pasteurizing milk.

28. Compare relative number of bacteria in certified milk, pasteurized milk, and milk bought on the streets. (Performed by instructor.)

29. Compare keeping quality of pasteurized and unpasteurized milk.

30. Examine fat globules with microscope.

III. Practice work with hogs.

1, 2, 3, 4 and 5 should correspond to laboratory exercises numbers 1, 2, 3, 4 and 5 under horse, using hogs as a study instead of horses.

6. Visit a hog farm and observe the methods of handling the herd. Look carefully into housing conditions, sanitation, water supply, condition of pens, feeding floors, troughs, dipping tanks, pasture, etc. Make complete notes on all that you see, and report conditions in class. The reports should be followed by a round-table discussion.

7. Have the students examine the hogs on their farms for lice. Let them prepare dips for lice and apply them to the infected herds. If there are any mangy hogs in the community, have them treat these also.

8. See number 8 under cattle.

9. Encourage some of the boys to make feeding experiments in fattening hogs. Have one begin feeding a pig as soon as it can eat, and fatten it off at about eight or nine months old. Have another begin feeding a pig when it is eight or nine months old; another a pig eighteen months old, etc. Have each one keep accurate records of the amount of feed used, gains made, cost, etc., and compare results.

10. If it is possible, give a demonstration of vaccination for hog cholera, and have not only the students of agriculture, but the whole school and all the visitors you can get present when it is given.

11. Take the class to the home of some farmer who happens to be killing his year's meat. Have them take notes on the temperature of the weather, the method of killing the hogs, the handling of the hog before cutting it into pieces, the cuts of the meat, methods of curing, etc. Discuss the best methods of doing these things and compare with methods commonly used.

IV. Practice work with sheep.

1. Study the score card until familiar with all the points. Procure some fine-wool, medium-wool, and long-wool sheep for scoring. With the ideal of the type in mind score several individuals of each type and compare and check scores.

2. Procure different types and breeds of sheep and have students judge them. Discuss the merits of each animal and reasons for placing.

3. Take the class to the home of a farmer who owns a few sheep and let them observe his methods of shearing. After discussing the best methods of shearing sheep, have each of the students try it. Special attention should be given to the position and method of holding the sheep while shearing.

4. Prepare dips for ticks, scab, foot rot, etc., and dip some farmer's sheep for him if they need it.

5. Either visit a slaughter house to observe the preparation, and a meat market to study the different cuts of meat, or buy a sheep, kill it, prepare it for the market and sell it. Have the students do all the work.

6. Procure samples of wool from the fine-wool, medium-wool, and long-wool types. Compare these samples. Procure several samples from different breeds of each type and place them according to their superiority.

V. Practice work in poultry.

1. Judge types and breeds of poultry. Visit poultry yards, poultry shows, and poultry farms.

2. Plan poultry houses, nests, coops, hoppers, etc.

3. Study feeds, and practice compounding rations.

4. Study the construction of an incubator and practice operating an incubator.

5. Give practice in the use of brooders.

6. Give practice in feeding young chicks. Test different rations.

7. Fatten birds for market; test pen fattening and crate fattening.

8. Give practice in killing and dressing poultry. Visit poultry yards and observe dressing and packing poultry.

9. Give practice in sorting and grading eggs; candling eggs; preserving eggs with waterglass, salt, etc.

10. Make study of fresh eggs, uncooked and hard boiled.

11. Observe stages in the incubation of chicks.

12. Study insects and diseases of poultry, and apply remedies.

(From the practice in animal husbandry suggested above, select exercises according to equipment, time, and local conditions.)

REFERENCE MATERIAL IN ANIMAL HUSBANDRY.

I. Minimum.

1. Craig: Judging Live Stock (Kenyon Printing and Manufacturing Co., Des Moines, Iowa), \$1.50.
2. Davenport: Principles of Breeding (Ginn & Co., Dallas), \$2.50.
3. Eckles: Dairy Cattle and Milk Production (Macmillan Co., Dallas), \$1.60.
4. Henry: Feeds and Feeding (W. A. Henry, Madison, Wis.), \$2.25.
5. Lewis: Productive Poultry Husbandry (Lippincott, Philadelphia), \$2.00.
6. Plumb: Types and Breeds of Farm Animals (Ginn & Co., Dallas), \$2.00.
7. Robinson: The Principles and Practice of Poultry Culture (Ginn & Co., Dallas), \$2.50.
8. Van Slyke: Modern Methods of Testing Milk and Milk Products (Orange Judd Co., New York), \$1.00.
9. Wing: Milk and Its Products (Macmillan Co., Dallas), \$1.50.

II. Other books desirable.

1. Horses.

- (1) Chawner: Diseases of the Horse and How to Treat Them (Orange Judd Co., New York), \$1.25.
- (2) Dadd: Modern Horse Doctor (Orange Judd Co., New York), \$1.00.
- (3) Say: Productive Horse Husbandry (Lippincott, Philadelphia), \$1.50.
- (4) Harper: Management and Breeding of Horses (Orange Judd Co., New York), \$2.00.
- (5) Knight: Jacks, Jennets and Mules (Orange Judd Co., New York), \$1.50.
- (6) Roberts: The Horse (Orange Judd Co., New York), \$1.25.

2. Hogs.

- (1) Coburn: Swine in America (Orange Judd Co., New York), \$2.50.
- (2) Cooch: Five Hundred Swine Questions Answered (Webb Publishing Co., St. Paul), 25c.
- (3) Craig: Diseases of Swine (Orange Judd Co., New York), 75c.
- (4) Day: Productive Swine Husbandry (Lippincott, Philadelphia), \$1.50.
- (5) Dawson: Hog Book (Sanders Publishing Co., Chicago), \$1.50.
- (6) Dietrich: Swine Breeding, Feeding and Management (Sanders Publishing Co., Chicago), \$1.50.
- (7) Fulton: Home Pork Making (Orange Judd Co., New York), \$1.50.
- (8) McIntosh: Diseases of Swine (Orange Judd Co., New York), \$2.00.

3. Sheep and goats.

- (1) Clarke: Modern Sheep: Breeds and Management (American Sheep Breeder Co., Chicago), \$1.50.
- (2) Coffey: Productive Sheep Husbandry (Lippincott, Philadelphia), \$1.50.
- (3) Rushworth: Sheep and Their Diseases (Alexander Eger, Chicago), \$1.50.
- (4) Stewart: The Shepherd's Manual (Orange Judd Co., New York), \$1.00.
- (5) Thompson: Angora Goat Raising and Milk Goats (Orange Judd Co., New York), \$1.00.
- (6) Wing: Sheep Farming in America (Sanders Pub. Co., Chicago), \$1.00.

4. Beef cattle.

- (1) Sanders: Shorthorn Cattle (Sanders Pub. Co., Chicago, Ill.), \$2.00.
- (2) Shaw: The Management and Feeding of Cattle (Orange Judd Co., New York), \$1.25.

5. Dairy cattle and dairying:

- (1) Conn: Practical Dairy Bacteriology (Orange Judd Co., New York), \$1.25.
- (2) Melich: Dairy Laboratory Guide (Van Norstrand Co., N. Y.), \$1.25.
- (3) Michels: Dairy Farming (J. Michels, Milwaukee), \$1.00.
- (4) Michels: Market Dairying (J. Michels, Milwaukee), \$1.00.
- (5) Peck: Profitable Dairying (Orange Judd Co., New York), 75c.
- (6) Puxley: Modern Dairy Farming (Scribners, New York), \$1.40.
- (7) Ross: A Dairy Laboratory Guide (Orange Judd Co., New York), 50c.
- (8) Russell and Hastings: Experimental Dairy Bacteriology (Ginn & Co., Dallas), \$1.00.
- (9) Stewart: Dairyman's Manual (Orange Judd Co., New York), \$1.50.

6. Poultry.

- (1) Brigham: Progressive Poultry Culture (Torch Press, Cedar Rapids), \$1.50.
- (2) Doyle: Illustrated Book of Domestic Poultry (Winston Co., Philadelphia), \$2.50.
- (3) Fiske: Poultry Feeding and Fattening (Orange Judd Co., New York), 50c.
- (4) Howard: American Fanciers' Poultry Book (Howard Publishing Co., Washington, D. C.), 50c.
- (5) Myrick: Turkeys and How to Grow Them (Orange Judd Co., New York), \$1.00.
- (6) Powell: Making Poultry Pay (Orange Judd Co., New York), \$1.00.
- (7) Sewell & Tilson: Poultry Manual (Webb Pub. Co., St. Paul), 50c.
- (8) Valentine: The Beginner in Poultry (Macmillan Co., Dallas), \$1.50.
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- (10) Watson: Farm Poultry (Macmillan Co., Dallas), \$1.50.

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- (1) Burkett: First Principles of Feeding Farm Animals (Orange Judd Co., New York), \$1.50.
- (2) Burkett: Farm Stock (Orange Judd Co., New York), \$1.50.
- (3) Harper: Animal Husbandry for Schools (Macmillan Co., Dallas), \$1.50.
- (4) Jordan: The Feeding of Animals (Macmillan Co., Dallas), \$1.50.
- (5) Marshall: Breeding Farm Animals (Sanders Pub. Co., Chicago), \$1.50.

- (6) Plumb: *Beginnings in Animal Husbandry* (Webb Pub. Co., St. Paul), \$1.25.
- (7) Shaw: *The Study of Breeds* (Orange Judd Co., New York), \$1.50.
- (8) Smith: *Veterinary Physiology* (Wm. R. Jenkins, New York), \$4.25.

III. Bulletins and other publications.

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2. Bulletin No. 141: *Improvement of Farm Egg* (U. S. Bureau of Animal Industry).
3. Bulletin No. 282: *Seven Methods of Feeding Young Chicks* (Cornell Experiment Station).
4. Bulletin No. 147: *Fattening Cattle in Alabama* (U. S. Bureau of Animal Industry).
5. Bulletin No. 163: *Steer Feeding in Alabama* (Alabama Exp. Station, Auburn).
6. Bulletin No. 118: *Silage for Steers* (Penn Exp. Station, State College).
7. Bulletin No. 76: *Experiments in Steer Feeding* (Texas Exp. Station, College Station).
8. Bulletin No. 11: *Dairy Industry in Texas* (Texas Exp. Station, College Station).
9. Bulletin No. 122: *Testing the Dairy Cow* (Ohio Exp. Station, Wooster).
10. Bulletin No. 78: *Feeding Fermented Cotton Seed Meal to Hogs* (Texas Exp. Station, College Station).
11. Bulletin No. 131: *Hog Feeding Experiments* (Texas Experiment Station, College Station).
12. Bulletin No. 168: *Fattening Hogs in Alabama* (Alabama Exp. Station, Auburn).
13. Bulletin No. 207: *Hog Raising in North Carolina* (N. C. Experiment Station, West Raleigh).
14. Bulletin No. 94: *Hog Feeding* (Oklahoma Exp. Station, Stillwater).
15. Bulletin No. 30: *Baby Beef* (Texas Department of Agriculture, Austin).
16. Bulletin No. 31: *Swine Management in Texas* (Texas Department of Agriculture, Austin).
17. Circular No. 125: *Sheep Industry from the Market Standpoint* (Illinois Experiment Station, Urbana).
18. Bulletin No. 17: *Draft Horse Judging* (Wisconsin Univ., Madison).
19. Bulletin No. 153: *Dissemination of Disease by Dairy Products* (U. S. Bureau of Plant Industry).
20. Bulletin No. 153: *Feeding Dairy Cows* (Illinois Experiment Station, Urbana).
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22. Circular No. 100: Rapid Method for Determination of Water in Butter.
23. Circular No. 103: Records of Dairy Cows.
24. Circular No. 126: A Simple Method of Keeping Creamery Records.
25. Circular No. 131: Designs for Dairy Buildings.
26. Circular No. 136: How to Build a Stave Silo.
27. Circular No. 142: Some Important Factors in the Production of Sanitary Milk.
28. Circular No. 171: Fermented Milk.
29. Circular No. 184: The Pasteurization of Milk.
30. Circular No. 195: A Plan for a Small Dairy House.
31. Circular No. 197: Directions for Home Pasteurization of Milk.
32. Circular No. 199: Score Card System of Dairy Inspection.
33. Circular No. 218: Legal Standards for Dairy Products.

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34. No. 49: Sheep Feeding.
35. No. 51: Standard Varieties of Chickens.
36. No. 55: The Dairy Herd; Its Formation and Management.
37. No. 64: Ducks and Geese.
38. No. 96: Raising Sheep for Mutton.
39. No. 106: Breeds of Dairy Cattle.
40. No. 126: Practical Suggestions for Farm Buildings.
41. No. 131: Household Tests for Detection of Oleomargarine, and Renovated Butter.
42. No. 137: The Angora Goat.
43. No. 142: Principles of Nutrition and Nutritive Value of Foods.
44. No. 159: Scab in Sheep.
45. No. 166: Cheese-making on the Farm.
46. No. 170: Principles of Horse Feeding.
47. No. 179: Horseshoeing.
48. No. 200: Turkeys, Standard Varieties and Management.
49. No. 201: Cream Separator on Western Farms.
50. No. 205: Pig Management.
51. No. 206: Milk Fever, Its Simple and Successful Treatment.
52. No. 236: Incubation and Incubators.
53. No. 241: Butter-making on the Farm.
54. No. 258: Texas or Tick Fever, and Its Prevention.
55. No. 292: Cost of Filling Silos.
56. No. 346: Computations of Rations for Farm Animals by Use of Energy Values.
57. No. 349: The Dairy Industry in the South.
58. No. 355: A Successful Poultry and Dairy Farm.

- 59. No. 363: Use of Milk as Food.
- 60. No. 413: The Care of Milk and Its Use on the Farm.
- 61. No. 438: Hog Houses.
- 62. No. 445: Marketing Eggs Through the Creamery.
- 63. No. 452: Capons and Caponizing.
- 64. No. 487. Cheese and Its Economical Uses in the Diet.
- 65. No. 490: Bacteria in Milk.
- 66. No. 498: Methods of Exterminating the Texas Fever
Tick.
- 67. No. 528: Hints to Poultry Raisers.
- 68. No. 530: Important Poultry Diseases.
- 69. No. 569: Texas or Tick Fever.
- 70. No. 574: Poultry House Construction.

· HALF-UNIT IN DAIRYING.

I. Introduction.

Extent of dairy business; dairy regions in United States; dairying in the South; dairying in Texas; advantages and disadvantages in dairy business; importance of dairy cows on the farm.

II. Dairy cattle.

1. Dairy type.
2. Dairy cow as a machine; factors affecting efficiency.
3. Dairy breeds:
 - (1) Major breeds: Holstein-Friesian; Jersey; Guernsey; Ayrshire; Brown Swiss.
 - (2) Minor breeds: Dutch Belted; Kerry; French Canadian.
 - (3) Dual purpose: Shorthorn; Red Polled; Polled Durham; Devons.
4. Outline for studying each breed separately. (See pages 51-53, outline for beef cattle.)

III. Milk.

1. Secretion of milk.

Definition of milk; mammary glands; udder; milk veins; milk wells; capacity of udders; internal structure of udder and teats; milk cistern; milk ducts; milk follicles; process of secretion; incentives to secretion; animal's control of secretion; amount and duration of flow; effect of incomplete milking; effect of regularity and frequency of milking; effect of treatment of cow; effect of succeeding pregnancy.
2. Composition.

Milk constituents; specific gravity; fats; albuminoids; sugar; ash; gases; odors of milk; variations in quality.
3. Colostrum.

Characteristics; composition; function.
4. Milk testing.
 - (1) Importance of testing.
 - (2) History of testing.
 - (3) The Babcock test.

Simplicity; reliability; apparatus and reagents; calibration of glassware; explanation of the basis of the percentage reading; cleaning of glassware; centrifugal machine.
 - (4) Method of making test:
 - a. Sampling: importance; method; composite sample; care of samples; apparatus for sampling; preparation of sample for test bottle; temperature.

- b. Filling pipette: method; precautions.
 - c. Transferring milk to test bottle: method; precautions.
 - d. Adding acid: kind; amount; action of acid; precautions.
 - e. Mixing acid and milk: method; reason; precautions.
 - f. First whirling: time; purpose; speed.
 - g. Adding water: amount; temperature; purpose; effect of hard water.
 - h. Second whirling: time.
 - i. Second adding water: amount; purpose.
 - k. Reading results: temperature; meniscus; use of dividers; correct appearance of fat-column; defects in fat-column and their causes.
 - l. Precautions in testing.
5. The care and handling of milk.
- (1) Bacteria in milk.

Kinds: harmful, harmless, useful; sources; factors favoring development; retardation of growth; pasteurization; sterilization; bacteria a measure of dirt.
 - (2) Souring of milk.

Cause; source of bacteria; test for lactic acid; conditions favorable for souring; starters.
 - (3) Other fermentations.
 - a. Normal: peptogenic and putrifactive; fermentation of albuminoids; butyric fermentation of fats.
 - b. Abnormal: sweet curdling; ropy, slimy or stringy milk; bitter milk; alcoholic fermentation; chromogenic fermentations, such as bloody milk, etc.
 - (4) Odors in milk.

Milk as an absorbent of odors; precautions in feeding silage; care of refrigerator or milk house; care of pasture; choice of feed; bacterial action affecting odor and flavor.
 - (5) Keeping of milk and cream: temperature, cleanliness; care of utensils; length of time.
6. Separation of cream.
- (1) Shallow-pan creaming: advantages and disadvantages; efficiency.
 - (2) Deep-setting creaming: advantages and disadvantages; efficiency.
 - (3) Dilution system of creaming: advantages and disadvantages; efficiency.
 - (4) Centrifugal separation.
 - a. Separators: kinds; basic principles; relative prices and efficiency; structure.

- b. Factors affecting efficiency: rate of inflow; speed of the bowl; temperature of milk; certain modifications in the structure of the bowl; lack of smoothness in running due to unbalanced bowl, poorly adjusted bearings or lack of solid foundation.
 - c. Factors regulating richness of cream: regulation of cream screw,—principles, method of adjustment, limit of adjustment, relation of thickness of cream to efficiency of separation; speed of machine; rate of inflow; temperature of milk.
7. Butter-making.
- (1) Ripening of cream.
Object of ripening; effect upon texture and flavor; temperature; amount of acid necessary; acid tests; effect of overripening; use of starter.
 - (2) Churning.
Kinds of churns; advantages and disadvantages of each; effect of viscosity; temperature; ripeness and size of fat globules of cream on churning; effect of period of lactation, breed, individuality, feed, etc., on churning; use of butter color; end of churning; factors affecting the product.
 - (3) Finishing the product.
 - a. Washing: importance and method; effect of temperature of wash water on texture of butter; effect of overwashing.
 - b. Working: importance; amount; apparatus and methods; effect of underworking and of overworking.
 - c. Salting: purpose; amount; method of application; purity of salt.
 - d. Packing and marketing: relation of moisture content to keeping of butter; kinds of moulds; prints and packages; temperature for moulding; marketing by retail and by wholesale.
 - e. Judging butter.
8. Brief study of cheese.
Nature of cheese; food value of cheese; milk best suited for cheese-making; manufacture of Cheddar cheese; making cottage cheese.
9. Certified milk.
Definition; origin; standards; precautions necessary for production; cost.

10. Milk products.

Butter; ice cream; skimmed milk; buttermilk; whey; condensed milk; dried casein; milk sugar; cheese; powdered milk; evaporated milk; condensed milk, etc.

11. Dairy laws and pure-food laws regarding dairy products.

IV. Milk production.

1. The herd.

Relation between breed and kind of dairy products desired; individuality in production.

2. Improvement of herd.

Testing and record keeping; weeding out low producers; breeding high producers; choice of herd bull; possibilities in grading up a herd; transmission of milking qualities.

3. Feeding for milk production: value of silage; silage crops; soiling system; pastures and forage crops; concentrates for dairy cattle; balanced ration; relation of production, live weight and individuality to amount of feed; feeding versus heredity in milk production.

4. Dairy barns.

Size; structure as to space, light, ventilation, temperature, floors, stanchions, feeding facilities, facilities for caring for manure and for flushing; drainage; sanitary conditions; location as to other buildings; material and cost.

5. Milk room.

Location; construction; equipment.

V. Dairying as a business.

1. Nature of the business; kind of work necessary; capital needed; returns expected.

2. Factors influencing location of dairy farm: market facilities for dairy products; facilities for feed production; water supply.

(For reference material and for practice work in dairying, see outlines of animal husbandry.)

HALF-UNIT IN POULTRY.

I. Introduction.

Value of poultry on the farm; comparison of value of poultry and poultry products with value of corn, oats, wheat, cotton, iron, silver or gold; value in Texas; growth of the industry; attractiveness; opportunity; requirements of a successful poultryman.

II. Types and breeds of chickens.

1. Nomenclature of bird: charts, drawings, etc.; basis of classification into types and breeds.
2. Meaning of types and breeds.
3. Meat type.
Characteristics of the type as to size, shape, disposition, production; breeds: Brahmas, Cochins, Langshans; characteristics of each.
4. Egg type.
Characteristics of the type as to size, shape, disposition, production, foraging, climatic adaptation, age of maturing, tendencies to sit; breeds: Leghorns, Minorcas, Andalusians, Spanish, Hamburgs; characteristics of each.
5. Dual-purpose type.
Characteristics of the type as to size, form, disposition, maturity, adaptation to climate, egg production, foraging, brooding; breeds: Plymouth Rocks, Wyandottes, Orpingtons, Rhode Island Reds, Dominiques, Dorkings, Houdans, Cornish Games, Javas; characteristics of each.
6. Fancy breeds.
Breeds: Bantams, Games, Polish, Frizzles, Sultans; characteristics of each.

III. Improvement of fowls.

Advantage of pure-bred over scrub. Variation in pure-breds as to production; use of trap-nest in selecting high-producing hens; selection as to constitutional vigor, physical perfection, breed shape, color of plumage, head appurtenances, etc.; factors to be considered in selecting for egg production and for meat production; value of the male bird in transmitting high productive qualities; selection of males; value of in-and-in breeding; danger of introducing new blood; ratio of females to males in the breeding pens.

IV. Houses and housing.

1. Location.
Convenience; drainage; sunlight; vermin.

2. Colony system versus single house.
3. Essential features of house.
Economy; convenience; sunlight; freedom from moisture; abundance of ventilation; plenty of room; protection from excessive heat or cold; proof against rats, mice, etc.; sanitation.
4. Size and type of house.
Size in relation to size of flock; material for floor, walls, roof, etc.; shape of building; provision for light, ventilation, etc.; portable houses.
5. Poultry fixtures.
Perches; dropping boards; nests; broody coops; dust boxes; feed troughs; drinking fountains; grit and shell boxes.

V. Yards and yarding.

Number and arrangement of yards: size; shape versus cost; method of double yarding and the crops to be used; fence material; height of fence; gate, etc.

VI. Egg production.

1. Age at which laying begins normally.
2. Causes of retarded laying.
3. Factors influencing egg production. Activity of reproductive organs; nourishment; comfort; exercise; constitutional vigor; sanitation; broodiness.
4. Moulting and egg production.
5. Variability in egg yields.
 - (1) In the same breeds.
 - (2) In different breeds.
6. Producing sterile eggs.
7. Effect of age on egg production.
8. Feeding for egg production.
Composition of eggs and its relation to ration; need of meat in ration; need of variety; need of green feed; balanced ration; need of pure water; mineral matter in the ration; use of grit; value of grinding grain; relation of fat to laying condition; value of exercise; various poultry foods.

VII. Incubation.

1. Study of the egg.
Nature of egg; purpose; parts of egg; source of each part; malformed eggs and their causes; fertile versus infertile eggs; candling to detect infertile eggs; numerous causes of infertility; stages of development in the embryo.
2. Eggs for incubation.
Collecting, selecting and keeping eggs for hatching.

3. Important factors in incubation.
Fertility; vitality of embryo; temperature; moisture; ventilation; shifting of egg.
4. Incubation by natural methods.
Nests as to material, location, and security; number of eggs; food and care of sitting hen; care of eggs and chicks at hatching time; advantages and disadvantages of the system.
5. Incubation by artificial methods.
History of artificial incubation; selection of incubator; study of construction and manipulation of incubator; placing the incubator; care of lamp; selection of eggs; regulation of temperature and moisture; turning and aeration of eggs; testing out infertile eggs; manipulation during hatching; keeping records.

VIII. Brooding.

1. Natural brooding.
Advantages; breeds of hens best suited; choice of individual; coops and runs; age to allow liberty of chicks and of mothers; number chicks per hen.
2. Artificial brooding.
 - (1) Fireless brooder—Philo system: principles; advantages; efficiency.
 - (2) Artificially heated brooders.
Kinds of brooders and sources of heat; brooder houses; runs and yards for chicks; need of cleanliness, sunlight, proper temperature, exercise and ventilation; cause of high mortality in brooder; hardening process; age to remove from brooder.

IX. Growing the chick.

1. Feeding.
Source of food for the growing embryo; age at which supply is exhausted; time feeding should begin; food to start chicks; later rations; teaching the brooder chick to eat; feeding brooder chicks versus chicks with hens; dry feeds versus mashies; green feeds; grits; frequency of feeding.
2. Factors affecting growth.
 - (1) Inherited characteristics.
 - (2) Environmental conditions.
Free range; green feed; shade; housing; management.
 - (3) Rate of growth.
 - (4) Separation of sexes while growing.
 - (5) Separation according to age and size.

X. Fattening poultry.

1. Age.
Comparison of broilers, friers and roasters as to breeds best adapted; profits expected; management necessary.
2. Feeding.
Effect of fattening on appearance and quality of fowl; cramming; fattening period; fattening rations.

XI. Capons and caponizing.

1. Process.
 - (1) Instruments: spoon and hook, forceps and knife, cannula and spreader; desirable characteristics of instruments.
 - (2) Age for caponizing.
 - (3) Preparation of birds: abstinence from feed and water; purpose.
 - (4) Operation: securing bird; place for cut; removal of feathers; incision; spreading; rupture of peritoneum; removal of testicles; precautions; treatment after operation.
2. Capons.
 - (1) Effect of caponizing: change of disposition; change of form and appearance; effect on quality of meat; effect on ease of fattening; "slips" and the cause.
 - (2) Market requirements.
 - (3) Breeds best adapted to caponizing.
 - (4) Profits.

XII. Preparation for market or for table.

1. Fasting: purpose, importance.
2. Killing.
Wringing the neck; cutting off the head; sticking; advantages of each method.
3. Removing feathers.
Scalding and dry picking; advantages of each; market requirements on picking.
4. Dressing: market requirements; relative prices of drawn and undrawn poultry.
5. Chilling: importance, temperature, time.
6. Shaping.
7. Grading: firsts; seconds; culls.
8. Packing: dry packing, ice packing.

XIII. Shipping live poultry.

1. Kind of coop to use.
2. Size of coop.
3. Cars for shipping.

4. Care of poultry on long shipments.
5. Sorting and grading.
6. Prices for different classes.

XIV. Marketing eggs.

1. Cleaning.
2. Sorting for color.
3. Sorting for size.
4. Boxes and cases for packing.
5. Preserving.
 - (1) Cold storage.
 - (2) Water glass.
 - (3) Lime water.
 - (4) Salt.

XV. Study of poultry other than chickens.

1. Kinds.
 - (1) Turkeys; (2) geese; (3) ducks; (4) guineas; (5) peafowls; (6) pheasants.
2. Outline for brief study of each.
 - (1) Types and breeds.
 - (2) Importance of the industry.
 - (3) Care and management.
 - (4) Preparation, marketing and use of products.

XVI. Insects and diseases of poultry.

1. Common ailments.

Roup; tuberculosis; limberneck; indigestion; scabby legs; cholera; white diarrhoea; pneumonia, etc.
2. Internal parasites.

Gapeworms; tapeworms; round worms, etc.
3. External parasites.

Lice, mites, etc.
4. Prevention and remedial work.
5. General sanitation and disinfectants.

(For reference material and practice work on poultry see the outline of animal husbandry.)

SOILS AND SOIL FERTILITY.

I. Soil,—definition.

1. Surface soil.
2. Subsoil,—differs from surface soil in that it
 - a. Contains less vegetable matter.
 - b. Is more compact.
 - c. Is usually lighter in color.
 - d. Is usually unproductive.
3. Functions of subsoil.
 - a. To renew mineral plant food depleted in surface soil.
 - b. To act as a retaining medium for roots of plants.
 - c. To serve as a storehouse for water.

II. Origin of soil: directly or indirectly from disintegration of rocks.

1. Causes of disintegration.
 - a. Changes of temperature.
 - b. Wind blowing sand against rocks.
 - c. Water dissolving some of the elements.
 - d. Transporting agencies, etc.
2. Agencies active in soil formation.
 - a. Changes in temperature.
 - b. Gravity.
 - c. Moving water.
 - d. Moving ice.
 - e. Winds.
 - f. Chemical action of air and water.
 - g. Action of living plants and animals.
 - h. Effect of organic matter.

III. Classification of soils according to method of formation.

1. Sedentary soils.
2. Transported soils.
 - a. Alluvial soils.
 - b. Colluvial soils.
 - c. Drift soils.
 - d. Wind-blown or Aeolian soils.
3. Study each of the above named soils as to
 - a. How formed.
 - b. Characteristics.
 - c. Where found.
 - d. Agricultural importance.

IV. Types of soils.

1. Light and heavy soils.
 - a. Basis of classification.
 - b. List of light soils.
 - c. List of heavy soils.

2. Warm and cold soils.
 - a. Factors influencing temperature of soils.
 - (1) Color.
 - (2) Moisture content.
 - (3) Composition of soil.
 - (4) Fineness of soil particles.
 - (5) Exposure, etc.
 - b. List of soils usually classed as warm soils.
 - c. List usually classed as cold soils.

V. Principal components of soils.

1. Sand: aids some soils by
 - a. Making them more porous for air and water.
 - b. Raising the temperature.
2. Clay.
 - a. Absorbs and retains mineral plant-foods needed in plant nutrition.
 - b. Usually is higher in potash.
3. Lime.
 - a. Aids in formation of nitrates in the soil.
 - b. Promotes decomposition of vegetable matter.
 - c. Overcomes sticky tendency of particles.
 - d. Improves absorptive and retentive power of sandy soil.
 - e. Neutralizes soil acidity.
4. Humus.
 - a. Functions of humus.
 - (1) Serves as a nitrogen supply.
 - (2) Supplies mineral plant-foods.
 - (3) Increases water holding capacity of soils.
 - (4) Is a source of warmth.
 - (5) Improves the soil texture.
 - (6) Aids bacterial and other micro-organic growth in the soil.
 - b. Loss of humus.
 - (1) By continued growth of tilled crops.
 - (2) By oxidation and leaching, especially in loose soils of the South.
 - (3) By great prairie fires.
 - c. Maintaining and building up humus content.
 - (1) Maintaining permanent pastures and meadows.
 - (2) Green manuring.
 - (3) Use of farm manures.

VI. Classes of farm soils with reference to their constituents.

1. Coarse sand.
2. Sandy soils.
3. Sandy loam.
4. Loam soils.

5. Silt loam.
6. Clay loam.
7. Heavy clay.
8. Black prairie soils.
9. Vegetable or swamp soils.
10. Study each of the above named soil types according to the following outline:
 - a. Where found.
 - b. Peculiar characteristics.
 - c. Agricultural importance.
 - d. Crops best adapted to it.

VII. Classes of soils with reference to moisture: arid; semi-arid; humid.

VIII. Study each of the above named soils as follows:

- a. Where found.
- b. Natural vegetation.
- c. Kind of farming.
- d. Agricultural importance.
- e. Land values in each section.

IX. Soil moisture.

1. Kinds of soil moisture.
 - a. Gravitational.
 - b. Capillary.
 - c. Hygroscopic.
2. Uses of soil moisture.
 - a. Dissolves mineral plant foods and renders them available for plants.
 - b. Transfers plant foods from soil to plant.
 - c. Principal component of circulatory fluid of plants.
 - d. Regulates soil temperature.
 - e. Regulates plant temperature.
3. Water capacity of different types of soils.
4. Amount of water required by different crops.
5. Methods of controlling soil moisture.
 - a. Best methods of conserving moisture.
 - b. Brief study of irrigation and drainage.

X. Soil ventilation.

1. The amount of air present in soils depends upon
 - a. The soil texture.
 - b. The structure of the soil.
 - c. The amount of organic matter present.
 - d. The amount of moisture in the soil.
2. The supply of soil-air may be controlled in part by
 - a. Cultivation.
 - b. Kinds of crops grown.
 - c. Organic matter added to soil.

3. Functions of soil-air.

- a. Aids in decomposition of organic matter.
- b. Chemical action on mineral substances renders them available to plants.
- c. Necessary to germination of seeds.
- d. Essential to root growth.

XI. Soil temperature.

1. Importance of proper soil temperature.
2. Influence of temperature upon germination and growth.
 - a. Optimum conditions for different crops.
 - b. Minimum requirements for different crops.
3. Influence on nitrification.
4. Conditions affecting soil temperature.
 - a. Color of the soil.
 - b. Amount of vegetable matter present in the soil and rate of decomposition.
 - c. Amount of soil moisture.
 - d. Rate of evaporation.
 - e. Slope and situation.
 - f. Smoothness and compactness of surface soil.
 - g. Tilth of surface and subsoil.

XII. Chemical composition of soils.

1. Chemical plant foods absolutely essential to plant growth: carbon; hydrogen; oxygen; nitrogen; phosphorus; potassium; calcium; sulphur; magnesium; iron; probably chlorin.
2. Elements that frequently must be supplied: nitrogen; phosphorus; potassium; calcium.
3. Nitrogen.
 - a. Functions of nitrogen.
 - b. Amount used by different crops.
 - c. Source of all nitrogen.
 - d. Nitrogen cycle.
 - e. How lost from soil.
 - f. How maintained.
 - g. Replacing in depleted soils.
 - h. Importance of legumes in relation to nitrogen content of soil.
4. Phosphorus.
 - a. Relation to plant growth.
 - b. Supply of earth's crust.
 - c. Supply available for plants.
 - d. Amount removed in different crops.
 - e. Amount returned in manures.
 - f. Depletion of phosphorus content of soil.
 - g. How restored.
 - h. Source of all commercial phosphorus.
 - i. Fertilizers used for phosphorus.

- (1) Acid phosphate.
 - (2) Ground rock phosphate.
 - (3) Bone meal.
 - (4) Steamed bone meal, etc.
 - j. Study the fertilizers named above, as well as others, as to
 - (1) Fertilizing value.
 - (2) Availability.
 - (3) Time to apply.
 - (4) Method of applying.
5. Potash.
- a. Distribution of potassium in earth's crust.
 - b. Soils usually rich in potash.
 - c. Soils usually deficient in potash.
 - d. Source and supply of commercial forms.
 - (1) Wood ashes.
 - (2) Giant kelp on Pacific coast.
 - (3) Mineral salts.
 - e. Most common commercial fertilizers used for potash.
 - f. Amount of potash removed in different crops.
 - g. Quantity needed by crops and time to apply.
 - h. Form of potash best to apply.
6. Calcium.
- a. Chemical effect of lime on the soil.
 - (1) Renders potash more available.
 - (2) Combines with acid phosphate, thus preventing the latter from combining with iron or alumina, both of which are insoluble.
 - (3) Promotes the decomposition of organic substances.
 - (4) Favors the change of ammonia into nitric acid.
 - (5) Corrects soil acidity.
 - (6) Renders injurious compounds of iron harmless.
 - b. Mechanical effect on soil: Makes soil more mellow and easier tilled.
 - c. Tests for lime.
 - (1) Chemical analysis.
 - (2) Muriatic acid test.
 - (3) Litmus paper test.
 - (4) Study of natural vegetation.
 - d. Crops usually benefited by liming.
 - e. Fertilizers used to supply lime.
 - (1) Superphosphates.
 - (2) Wood ashes.
 - (3) Ground limestone.
 - (4) Ground shells.
 - (5) Burned lime.
 - f. Amount of lime to use.

- g. Best season to apply lime.
- h. Frequency of applying.
- i. Method of applying.

XIII. Farm manures.

1. Importance of farm manures.
2. Comparative composition of liquid manure and solid manure.
3. Factors affecting value of manures.
 - a. Food of the animal.
 - b. Age of the animal.
 - c. Kind of animal.
 - d. Kind and amount of litter used.
 - e. Care of the manure.
 - f. Moisture content of manure.
4. Relative value of the manure from different classes of farm animals.
5. Care and handling of manure on the farm.
 - a. Methods of handling before applying.
 - (1) Allowing manure to collect in stalls.
 - (a) Necessity of good bedding.
 - (b) Advantages and disadvantages.
 - (2) Composts and composting: kind; cost.
 - (a) Location with reference to other buildings.
 - (b) Care of manure in the compost.
 - (c) Advantages and disadvantages.
 - (3) Chemical absorbents and reinforcements.
 - (a) Purposes of using them.
 - (b) Kind of material to use.
 - (c) Danger of using some chemical absorbents.
 - (d) How to use.
 - b. Application of manure.
 - (1) Applying fresh manure.
 - (a) Kind of crop and condition of soil.
 - (b) Advantages of applying fresh manure.
 - (2) Applying well rotted manure.
 - (3) Time to apply.
 - (4) Amount of manure to use.
 - (5) Condition of soil and kind of crop.
 - (6) Method of applying.
 - (7) Necessity of even application.
 - c. Losses of manure due to exposure.

XIV. Handling soils to maintain permanent soil fertility.

1. Proper rotation of crops.
 - a. Reasons for crop rotation.
 - (1) Plants use different proportions of soil constituents.

- (2) Plants feed at different depths.
- (3) Different crops require different cultural practices.
- (4) Insect pests and fungus diseases more easily controlled.
- (5) Economy of labor.
- b. Effect of rotation on production.
- c. Effect on soil fertility.
- d. Rotation suitable for farming in different parts of Texas.
- 2. Green manures.
 - a. Purpose of green manuring.
 - b. Effect on soil.
 - c. Effect on production.
 - d. Place in crop rotation.
 - e. Crop best suited for green manures.
 - f. Degree of maturity for turning under green manures.
 - g. Advantages of green manuring.
 - (1) Increases availability of mineral plant foods.
 - (2) Increases humus content and raises soil temperature.
 - (3) Increases moisture content of soil.
 - (4) Conserves nitrogen.
 - (5) Brings up plant food from subsoil and stores in the surface soil.
 - (6) Opens and mellows soils.
 - (7) Makes following crop deeper rooted and lessens drouth injury.
 - (8) Helps free the land from weeds.
 - (9) Aids in preventing erosion and blowing of soils.
- 3. Intelligent use of farm manures and commercial fertilizers.
- 4. Proper tillage.
 - a. Implements for cultivating the soil.
 - b. Plowing the land.
 - (1) Time to plow,—depends upon
 - (a) Kind of soil.
 - (b) Conditions of the soil.
 - (c) Slope of the land.
 - (d) Crop to be grown.
 - (2) Depth of plowing.
 - (3) Subsoiling.
 - c. Cultivation after breaking.
 - (1) Kind and amount.
 - (2) Purpose.
 - (a) To destroy weeds.
 - (b) To conserve moisture.
 - (c) To render plant food available.

- (d) To obtain an openness of texture and uniform soil condition.
- d. Summer fallowing.
 - (1) Purpose.
 - (2) Advantages.
 - (3) Losses due to fallowing.
- e. Best methods of cultivation for different sections of the state.

XIV. Building up worn-out soils.

PRACTICE WORK IN SOILS AND SOIL FERTILITY.

(Refer to laboratory manuals for detailed description of the various exercises.)

1. A field trip to note evidences of soil formation.
2. Practice in taking soil samples.
3. Examination of characteristics of sand, loam, clay.
4. Examination of soil and subsoil.
5. Examination of types of soil with their vegetation.
6. Examinations of soils that have been cropped differently.
7. Thoroughly mix samples of soil with water in tall glass cylinder, allow it to settle, and note the separation of particles according to size.
8. Stir samples of sand, loam, and clay with water to a stiff dough, mold into balls, and dry in sun or in oven.
9. Try alternately wetting and drying the clay mud ball. Try 1 per cent of lime in clay mud ball. If convenient, try freezing clay mud ball.
10. Compare power of sand, clay, and leaf mould to retain moisture by saturating with water the same weight of each and determining the increase in weight.
11. Percolation experiment with sand, loam, clay.
12. Capillarity experiment with sand, loam, clay.
13. Use clods and chaff to obstruct capillary rise of moisture in large glass tubes.
14. Test efficiency of dust mulch in conserving moisture.
15. Test effect of evaporation of moisture on temperature of soil on a clear day.
16. Test effect of color of soil on temperature on clear day.
17. Determine capillary moisture in field samples, and note effect of method of cropping and handling on moisture content.
18. Determine porosity, volume, weight, and apparent specific gravity of soils.
19. Determine loss in sample of soil on ignition. Note relation between type of soil, method of cropping, and handling, and loss on ignition.
20. Examine various kinds of fertilizer materials.
21. Run fertilizer tests either in field or in pots.
22. Examine root system and tubercles of cowpeas, soy beans, alfalfa, etc. Dig up an average plant with care to get as near all the root system as possible. Count the number of plants on a square foot. Cal-

culate approximately the weight of *air-dry organic* matter per acre added by turning under the crops. Calculate the approximate weight of hay per acre the field will yield. Supposing that two-thirds of the nitrogen in the entire plant is obtained from the air and one-third from the soil, and that two-thirds of the nitrogen of the plant is in the top (hay) and one-third in the roots and stubble, how much nitrogen is added to the soil if the hay crop is removed from the field? How much if the crop is turned under? How much corn or cotton might be expected from the added nitrogen? What is the value of the nitrogen added? What is the value of the potash and phosphoric acid turned under? How does the value of plant food turned under compare with the value of animal food turned under? What is the net weight and value of plant food added to the soil in consequence of growing and turning under the crop?

(When time does not permit each student to perform each exercise, the teacher may assign some exercises to certain students and require all the students to make observation and write up the results. Plan sufficient work for each day for each student so that he will have no time to waste.)

REFERENCE MATERIAL IN SOILS AND SOIL FERTILITY.

I. Minimum.

1. Hopkins: Soil Fertility and Permanent Agriculture (Ginn & Co., Dallas), \$2.25.
2. King: Physics of Agriculture (F. H. King, Madison, Wis.), \$1.75.
3. King: The Soil (Macmillan Co., Dallas), \$1.50.
4. Lyon and Fippin: The Principles of Soil Management (Macmillan Co., Dallas), \$1.75.
5. Voorhees: Fertilizers (Macmillan Co., Dallas), \$1.25.

II. Other books desirable.

1. Burkett: Soils (Orange Judd Co., New-York), \$1.25.
2. Fletcher: Soils (Doubleday, Page & Co., Garden City, N. Y.), \$2.00.
3. Hall: Fertilizers and Manures (E. P. Dutton & Co., N. Y.), \$1.50.
4. Hall: Soil (E. P. Dutton & Co., N. Y.), \$1.50.
5. Harris: Talks on Manures (Orange Judd Co., N. Y.), \$1.50.
6. Hilgard: Soils (Macmillan Co., Dallas), \$4.00.
7. McCall: Physical Properties of Soil (Orange Judd Co., N. Y.), 50c.
8. Mosier: Laboratory Manual for Soil Physics (E. H. Reid, Bremer School, Minneapolis), 30c.
9. Murray: Soils and Manures (Van Nostrand, New York), \$2.00.
10. Roberts: Fertility of the Land (Macmillan Co., Dallas), \$1.50.

11. Shaw: Dry Land Farming (Orange Judd Co., New York), \$2.00.
12. Snyder: Soils and Fertilizers (Macmillan Co., Dallas), \$1.25.
13. Stevenson and Schaub: Soil Physics Laboratory Guide (Orange Judd Co., New York), 50c.
14. Van Slyke: Fertilizers and Crops (Orange Judd Co., N. Y.), \$2.00.
15. Vivian: First Principles of Soil Fertility (Orange Judd Co., New York), \$1.00.
16. Warington: Physical Properties of Soil (Oxford University Press, New York), \$1.50.
17. Whitson and Walster: Soils and Soil Fertility (Webb Pub. Co., St. Paul), \$1.25.

III. Bulletins and other publications.

1. Bulletin No. 112: Nature and Uses of Commercial Fertilizers (Texas Experiment Station, College Station).
2. Bulletin No. 136: Organic Phosphoric Acid in the Soil (Texas Experiment Station, College Station, Texas).
3. Bulletin No. 156: The Phosphorus Compounds of Cotton Seed Meal and Wheat Bran (Texas Experiment Station, College Station, Texas).
4. Bulletin No. 161: The Composition of Soil of South Texas (Texas Experiment Station, College Station, Texas).

Soils Bureau Bulletins (U. S. Dept. of Agriculture, Washington, D. C.):

5. Bulletin No. 34: Reclamation of Alkali Soils.
6. Bulletin No. 35: Alkali Soils of United States.
7. Bulletin No. 40: Some Factors Influencing Soil Fertility.
8. Bulletin No. 48: Fertility of Soils as Affected by Manures.
9. Bulletin No. 56: Role of Oxidation in Soil Fertility.
10. Bulletin No. 62: Fertilizers for Cotton Soils.
11. Bulletin No. 64: Fertilizers for Corn Soils.
12. Bulletin No. 65: Fertilizers for Potato Soils.
13. Bulletin No. 66: Fertilizers for Wheat Soils.
14. Bulletin No. 67: Fertilizers on Soil Used for Oats, Hay and Miscellaneous Crops.
15. Bulletin No. 71: Soil Erosion.
16. Bulletin No. 79: Color of Soils.
17. Bulletin No. 115: Soil Improvement of Worn Hill Lands (Illinois Experiment Station, Urbana).
18. Circular No. 38: The Principles of Maintaining Soil Fertility (Missouri Experiment Station, Columbia).

Farmers' Bulletins (U. S. Dept. of Agriculture, Washington):

19. Bulletin No. 44: Commercial Fertilizers, Composition and Use.

20. Bulletin No. 48: Manuring of Cotton.
21. Bulletin No. 77: Liming of Soils.
22. Bulletin No. 88: Alkali Lands.
23. Bulletin No. 138: Irrigation in Field and Garden.
24. Bulletin No. 257: Soil Fertility, address delivered before Rich Neck Farmers' Club of Queene Anne County, Md.
25. Bulletin No. 266: Management of Soils to Conserve Moisture.
26. Bulletin No. 278: Leguminous Crops for Green Manuring.
27. Bulletin No. 421: Control of Blowing Soils.
28. Bulletin No. 537: How to Grow an Acre of Corn.

FIELD CROPS.

A. Corn.

I. History of corn.

1. Where first found.
2. By whom first cultivated.
3. Early distribution.
4. By what race of people cultivated at the present time.

II. Study of the corn plant.

1. Height of stalk.
2. Number of leaves per stalk.
3. Arrangement of leaves.
4. Height of ear from ground.
5. Flowering parts.
 - a. Tassels bearing staminate flowers.
 - b. Silks—pistillate flowers (see experiments Nos. 1 and 2, page 101).
6. Effect of self-fertilization.
7. Effect of cross-fertilization.
8. Root system.
 - a. Function of large roots above ground.
 - b. Function of smaller roots and root hairs.
 - c. Depth of root systems.
 - d. Spread of roots across rows.
 - e. Depth of roots below surface near plant.
 - f. Depth of roots below surface in the middle of rows.

III. Selection of seed corn.

1. Methods of selection.
 - a. Shock selection.
 - b. Selecting from crib.
 - c. Field selection.
2. Factors to consider in field selection.
 - a. General strength and vigor of the stalk.
 - b. Leafiness of stalk.
 - c. Size and height of stalk.
 - d. Number of stalks to hill.
 - e. Number of ears borne to the stalk.
 - f. Height of ear on stalk.
 - g. Size and shape of the ear.
 - h. Size and length of shank.

IV. Curing seed corn.

1. Factors to be considered.
 - a. Ventilation.
 - b. Dry atmosphere.
 - c. Freedom from exposure to direct rays of sun.

2. Devices to be used in the school-room for curing the corn.
 - a. Corn tree.
 - b. Corn rack.
 - c. Double string methods.
 - d. Single cord method.
 - e. Wire racks, etc.

V. Relation of climate to corn production.

1. Corn requires a high temperature during the growing season.
2. It requires long days of bright sunshine.
3. It needs a large amount of rain during the hot growing season.

VI. Soils best adapted to corn.

VII. Plowing for corn.

1. Time of plowing.
2. Advantages of late fall plowing.
 - a. Stores up moisture.
 - b. Freezing and thawing have mellowing effect upon land.
 - c. Freezing destroys insect larvae.
 - e. Economizes labor.
3. Spring plowing.
4. Depth of plowing for light soils.
5. Depth of plowing for heavy soils.
6. Subsoiling.

VIII. Preparing the seed bed after plowing.

1. Leave fall-plowed land in rough until spring.
2. Cultivate spring-plowed land immediately after plowing, especially if plowed late.
3. Advantages of frequent cultivation before planting.
4. Method of cultivating: discing, harrowing, etc., as condition demands.

IX. Seeding.

1. Importance of good, uniform seed. Reasons for discarding butts and tips.
2. Method of seeding.
 - a. In drills.
 - b. Check row system.
3. Depth of seeding. Listing.
4. Time of seeding.
 - a. Plant later in sod land to avoid injury from cut worms.
 - b. Be sure that soil is warm enough.
5. Rate of planting.
 - a. Distance between rows.
 - b. Number of kernels to hill if checked.

- c. Distance between kernels in drills if drilled.
- d. Rate of planting for fertile soil and good climatic conditions.
- e. Rate for poor soil and poor climatic conditions.

X. Cultivation after planting.

- 1. Purpose of cultivation.
 - a. To subdue weeds.
 - b. To conserve soil moisture.
 - c. To aerate the soil.
 - d. To improve the quality of the crop.
 - e. To improve the quantity of the crop.
- 2. Method of cultivation.
 - a. Level versus hilling.
 - b. Shallow versus deep.
- 3. Amount of cultivation.
- 4. Time to cultivate.

XI. Harvesting corn.

- 1. Degree of maturity to harvest for silage.
- 2. Degree of maturity to harvest for fodder.
- 3. Degree of maturity to harvest for ears.
- 4. Influence of maturity upon yield.
- 5. Influence of maturity upon composition.
- 6. Influence of maturity upon feeding value.

XII. Storing corn.

- 1. Condition of corn when stored.
- 2. Necessity of well ventilated granaries.
- 3. Necessity of tight cribs to protect from weevils.
- 4. Necessity of protection from mice and rats.
- 5. Best method of handling and storing stover.
- 6. Harvesting and storing in the silo.

XIII. Enemies of corn.

- 1. Weeds.
 - a. Ways in which they injure the crop.
 - b. Study and identification of weeds most troublesome in corn crop.
 - c. Best method of combating weeds.
- 2. Insect enemies: a brief study of the life history of the following, and of the injury caused by them: cut worms, white grubs, corn-ear worms, wire worms, chinch bugs.
- 3. Animal pests: rats, mice, gophers, muskrats, and squirrels.
- 4. Birds that destroy corn sometimes: crow, blackbird.
- 5. Fungus and bacterial diseases.
 - a. Smut.
 - (1) Source and mode of infection.
 - (2) Factors influencing extent of infection.

- (3) Amount of damage done.
 - (4) Preventive measures.
 - b. Bacterial diseases.
 - (1) Where found.
 - (2) Appearance of plants infected.
 - (3) Damage caused.
 - (4) Remedy.
 - c. Corn rust.
 - (1) Appearance.
 - (2) Prevalence.
 - (3) Conditions favorable.
 - (4) Injury.
 - (5) Remedy.
- XIV. Elements of plant food removed by corn crop.
 - 1. Amount removed in ears of fifty-bushel crop.
 - 2. Amount removed in stalks of fifty-bushel crop.
- XV. Fertilizing and manuring for corn crop.
 - 1. Kind and amount needed.
 - 2. Time to apply.
 - 3. Method of applying.
- XVI. Corn in crop rotations.
- XVII. Cost of producing an acre of corn.
 - 1. Cost of cultivation.
 - 2. Value of plant food removed.
 - 3. Rental value of land.
 - 4. Depreciation of farm machinery.
 - 5. Cost of harvesting, etc.
 - 6. Amount of corn necessary to be produced so as not to lose money.
- XVIII. Uses of corn.
 - 1. Food for domestic animals.
 - 2. Food for human consumption.
 - a. Hominy.
 - b. Corn meal bread.
 - c. Corn meal mush.
 - d. Roasting ears.
 - e. Canned corn, etc.
 - 3. Manufactured products.
 - a. Glucose.
 - b. Starch, uses of.
 - (1) Food.
 - (2) Laundry starch.
 - (3) Malting, etc.
 - c. Alcohol and whisky.
 - d. Pith of stalk used in manufacture of explosives and for packing sides of war vessels.

- e. Stalks used in manufacture of paper.
- f. Husks made into mats and mattresses.
- g. Corn cobs for pipes.
- 4. By-products from manufacture of whisky, starch and glucose: oil, gum, germ oil meal, gluten meal, bran, gluten feed, distiller's grains, brewer's grains.
(The last two named contain corn, barley and rye commonly, but are usually largely corn.)

XIX. Testing seed corn.

- 1. Importance of testing.
- 2. Value of individual-ear test.
- 3. Effect of poor seed on stand and yield.
- 4. Method of making individual-ear test.
- 5. Temperature required for test.
- 6. Time required for test.
- 7. Kind of tester used.

XX. Corn breeding.

- 1. Methods.
 - a. Straight selection.
 - b. Cross-fertilization.
- 2. Physical characters of the plant to be regarded in selection.
 - a. Shape of ear.
 - b. Size of ear.
 - c. Shape of kernel.
 - d. Height of ear.
 - e. Size of stalk.
 - f. Height of stalk.
 - g. Amount of leaf.
 - h. Length of shank.
 - i. Tillers.
 - j. Barren stalks.

XXI. Types of corn: pod corn, flint corn, soft corn, sweet corn dent corn.

XXII. Varieties of corn.

- 1. Northern varieties: Brewers' Yellow Dent, Minnesota No. 13, Wisconsin No. 7, Wisconsin No. 8, and Golden Glow.
- 2. Central varieties: Reed's Yellow Dent, Riley's Favorite, Leaming, Boone County White, Johnson County White, Pride of the North, Silver Mine, Golden Eagle, Bloody Butcher, and Strawberry.
- 3. Southern varieties: West's White Dent, Hickory King, Prolific, Texas Gourd Seed, Boone County White, Sure Cropper, Bloody Butcher, Mosby, Strawberry, Mexican June, and Munson.

B. Wheat.

I. History and distribution.

1. Early history of wheat.
2. Early distribution.
3. Introduction into the United States.
4. Spread in the nation.
5. Present distribution in Texas.
6. Present distribution in the United States.

II. Study of the wheat plant.

1. Culm.

a. Length of culm.

- (1) Influence on liability to lodge.
- (2) Influence on ease of harvesting.
- (3) Influence on yield.

b. Number and arrangement of leaves.

c. Structure.

- (1) Thickness of wall.
- (2) Hollow, hairy, rough, or grooved.

2. Leaves, their parts: blade, sheath, ligule, and leaf auricle.

3. Roots.

a. Number and arrangement of temporary roots on young plant.

b. Arrangement of permanent roots.

c. Depth of root system.

4. Stooling and tillering: effect of thick seeding on stooling.

5. Wheat flower.

a. Parts of the flower.

b. Arrangement of parts.

6. Spikelet.

a. Number of flowers in a spikelet.

b. Number of berries and number of sterile flowers.

c. Number and position of outer glumes.

7. Spike.

a. Name and arrangement of parts.

b. Number of spikelets.

c. Length of spike.

8. Fruit or grain.

a. Parts of wheat berry.

b. Relative value of parts commercially.

III. Botanical relations.

1. Species of wheat: Einkorn, Spelt, Emmer, Club, Durum, Alaska, Polish, Poulard, and common wheat.
2. Varieties of common wheat.
 - a. Winter wheat.

- (1) Soft winter wheat: Mediterranean, Fulcaster, Valley, Nigger, Kansas Mortgage Lifter, Early Genesee, Giant, Fultz.
- (2) Hard winter wheat: Turkey Red, Beloglenska, Kharkof, Malakoff, Crimean. Red Winter, Ghirka.
- b. Hard spring wheat: Fife, Blue Stem, Velvet Chaff.
- c. White wheat: California Club, Oregon Red Chaff, Sonora, White Winter, and Little Club. (May be either winter or spring varieties.)

IV. Improvement of varieties.

1. Breeding by straight selection.
2. Breeding by crossing varieties.

V. Climate as a factor in wheat production.

1. Effect of climate on geographical distribution in general.
2. Effect of climate upon distribution of spring and winter wheats.
3. Quality of wheat as affected by climate.
4. Yield as affected by climate.
5. Amount of rainfall necessary to production of wheat in different regions.
6. Effect of climate upon general growth of plant.

VI. Soils adapted for wheat.

1. Influence of soil on yield.
2. Influence of soil on winter killing.
3. Kind of soils best adapted to wheat.

VII. Fertilizers and manures for wheat.

1. Amount of plant food removed in grain and straw from average acre of wheat.
2. Kind and amount of commercial fertilizers required to replace plant food removed.
3. Time and method of applying commercial fertilizers.
4. Necessity of green manuring.
5. Importance of barn-yard manure and time to apply in rotation.
6. Effect on soil of continuous cropping.

VIII. Cultural methods.

1. Place of wheat in crop rotations.
2. Time to plow the land.
3. Depth of plowing.
4. Subsoiling.
5. Preparation of the seed bed without plowing.
6. Preparation of the seed bed after plowing.
7. Time of sowing.

8. Method of sowing. Advantages of drilling.
9. Depth of sowing.
10. Rate of seeding.
 - a. For fertile soil.
 - b. For thin soil.
11. Influence of size of seed upon yield.
12. Importance of fanning and screening seed carefully before sowing.
13. Spring cultivation of winter wheat.

IX. Enemies of wheat.

1. Insect pests.
 - a. Of growing grain.
 - (1) Kinds: chinch bug, joint worm, Hessian fly, wheat midge, grass hoppers, etc.
 - (2) Life history of one or two insects common to your locality.
 - (3) Method of control.
 - b. Of stored grain and grain products.
 - (1) Kinds: granary weevil, rice weevil, flour beetle, Mediterranean flour moth, etc.
 - (2) Life history of one or two most common ones.
 - (3) Method of control.
 - (a) Fumigation with sulphur, carbon bisulphide, or potassium cyanide.
 - (b) Raising temperature to 120 degrees or more for from twelve to twenty-four hours.
2. Animal and bird enemies: rats, mice, ground squirrels, English sparrows, etc.
3. Fungus diseases.
 - a. Kinds: rust, wheat scab, loose smut, stinking smut.
 - b. Economic importance of fungus diseases of wheat.
 - c. Brief study of life cycle of smuts.
 - d. Source of infection of smuts.
 - e. Remedial measures.
 - (1) Hot water treatment for loose smut.
 - (2) Hot water treatment, copper sulphate treatment, and formalin treatment for stinking smut.
4. Weeds as enemies of wheat.
 - a. How weeds injure growing grain.
 - b. Kind of weeds commonly found in wheat field.
 - c. Loss due to weed seed in threshed grain.
 - d. Best method of controlling troublesome weeds.

X. Harvesting and threshing.

1. Degree of maturity for harvesting.
 - a. Influence of maturity upon yield.
 - b. Influence of maturity upon composition.
2. Method of harvesting.
 - a. Machinery: reaper, self-binder, header, combined harvester and thresher.
 - b. Number of acres that can be handled conveniently by each.
 - c. Territories adapted to use of each.
3. Advantages of threshing wheat from shock.
4. Advantages of stacking.
5. Handling the threshed grain.

XI. Milling wheat.

1. Steps in milling: tempering, breaking, separation of bran, purifying, grading, rolling, and bolting.
2. Grades of flour produced for human food: first patent, second patent, patent, standard patent, long patent, straight, baker's or first clear, low grade or second clear.
3. Special flour for human food: Graham or whole wheat.
4. By-products used for animal food: bran, middlings, shorts, wheat screenings.

(In somewhat the same way the teacher may outline the work for oats, barley, rye, rice, and buckwheat. The local importance of the cereal and the time available will determine the extent to which each should be studied.)

C. Cotton.

I. Introduction.

1. Extent of industry: yield, acreage, value for Texas and for United States; cotton states and their rank in production; foreign countries producing cotton.
2. History of cotton industry: ancient production and use; growth of the industry in the United States; factors influencing this growth.
3. Effect of cotton industry on South: effect on soil, industries, education, population; demands for diversified farming.

II. Description of plant.

1. Stems and branches: vegetative and fruiting; cone-shaped and "cluster cottons"; correlation between types of stems and branches, and maturity and production.
2. Roots.
3. Leaves.
4. Boll stems or peduncles,—best types.

5. Flowers: "squares"; sepals; stamens; pistils; pollen; methods of pollination.
6. Bolls: locks; seeds; lint; "storm resistant" bolls; structure of boll.
7. Study of lint.
 - (1) Nature of lint.
 - (2) Kinds of fiber as to maturity: ripe, partly ripe, immature.
 - (3) Value of fiber: depends upon length, maturity, fineness, and uniformity.
8. Study of seed.
 - (1) Composition.
 - (2) Proportion of parts: linters, hulls, meats.
 - (3) Characteristics: size, shape, color, etc.
 - (4) By-products: cotton-seed meal, cotton-seed oil, linters, hulls, etc.

III. Cotton production.

1. Soils and climate: climatic conditions favorable to cotton; soils best adapted; relation between fertility and cotton production.
2. Fertilizers for cotton: effect of cotton on fertility of the soil; fertilizer equivalent of a bale of cotton to the acre; parts of the plant removing fertility; loss of fertility due to cultivation and leaching; commercial fertilizers recommended; green manuring and rotation of crops to conserve fertility.
3. Preparation of seed bed.
 - (1) Disposition of litter on ground, such as corn stalks, cotton stalks, etc.
 - (2) Breaking: time, depth, and manner.
 - (3) Bedding: advantages and disadvantages; bedding versus level planting; soils adapted to each; methods of forming the bed: distance apart.
4. Fertilizing: method of distribution, time, rate, etc.
5. Planting: time, rate, method, distance between rows.
6. Cultivation: "barring"; "siding"; cleaning middles; "chopping"; manual labor versus mule labor; improved machinery; shallow cultivation; duration of cultivation.

IV. Harvesting the crop.

1. Picking: picking season; hand picking,—average day's picking, cost, method; mechanical pickers,—type, cost, efficiency.
2. Ginning: nature of operation, history of cotton gin, effect of ginning damp cotton.
3. Baling: nature of process; size and weight of bale; covering; amount of tare; square bale versus round bale.
4. Compressing: nature; method; purpose; when used.

V. Marketing cotton.

1. Care of baled cotton: deterioration due to exposure to weather and mud; yarding; storage in warehouse,—cost, insurance, etc.; storing on the farm.
2. Marketing through agent.
3. Personal selling.
4. Cotton exchange: nature of business; rise of the exchange; effect on industry.
5. Commercial grades of cotton.
 - (1) Factors determining class of cotton: abundance of trash; color of fiber; amount of “nep” or tangled, immature fibers.
 - (2) “Full classes or grades: fair, middling fair, good middling, middling, low middling, good ordinary, ordinary.
 - (3) “Half grades”: strict middling fair, good middling, strict middling, etc.
 - (4) Grades usually found in Texas: strict good middling, good middling, strict middling, middling.
 - (5) Influence of length of fiber.
 - (6) Effect of tinges and stains.
 - (7) Differences in value due to grades.

VI. Types and varieties of cotton.

1. American upland cotton: groups, characteristics, and varieties.
 - (1) Cluster type.
 - (2) Semi-cluster type.
 - (3) Rio Grande type.
 - (4) Early King type.
 - (5) Big-boll type.
 - (6) Long-limbed type.
 - (7) Long-staple upland.
2. Sea-island cotton: location, characteristics of plant and fiber, value.
3. Other types: Peruvian, Indian, Bengal.

VII. Improvement of cotton.

1. Qualities desired.
 - (1) Large size of boll.
 - (2) Large number of bolls.
 - (3) Early maturity.
 - (4) Desired shape of plant.
 - (5) Freedom from disease.
 - (6) Uniformity in length of lint.
 - (7) Greater length of lint.
2. Methods of improvement.
 - (1) Selection; plant-to-row test; picking cotton for seed ahead of main pickers; advantages and disadvantages of the methods; common method of selecting seed.

- (2) Breeding and selection: advantages and inconveniences.
- (3) Varieties and types best suited to local conditions.

VIII. Insects and diseases of cotton.

1. Kinds of insect pests: boll weevil, cotton boll worm, cut worms, etc.
2. Study of each: life history, nature of injury, prevention and remedial measures.
3. Diseases of cotton: cotton wilt or black-root, root rot, root-knot, boll rot or anthracnose, cotton rust or black rust.
4. Prevention and remedial measures.

D. Legumes.

I. Meaning of the term *legume*.

II. Plants belonging to this family.

1. Alfalfa.
2. Clovers: medium red; mammoth; white; alsike; bur; sweet; crimson; Japanese; hop, etc.
3. Cowpeas.
4. Soy beans.
5. Canadian field peas and other peas.
6. Beans.
7. Peanuts.
8. Vetches, etc.

III. Value of legumes.

1. As a food for animals.
 - a. Relative protein content of alfalfa hay as compared with timothy hay.
 - b. Protein content of alfalfa hay as compared with wheat bran.
 - c. Protein content of medium red and alsike clover hay as compared with red top, Johnson grass, and Bermuda.
 - d. Protein content of cowpeas, soy beans, etc., as compared with hays from non-leguminous plants.
2. As soil improvers.
 - a. Add nitrogen to the soil.
 - (1) Brief review of necessary plant food elements.
 - (2) Examination of roots of legumes for nodules. Compare with roots of grasses.
 - (3) Relation of bacteria to legume.
 - (a) Plant furnishes carbohydrates, etc., to bacteria.

- (b) Bacteria furnishes nitrogen content of legumes.
- (4) Source of nitrogen used by bacteria.
- (5) Effect of nodules on nitrogen content of legumes.
- (6) Conditions affecting nodule formation.
 - (a) Inoculation of soil.
 - (a') Methods of inoculation.
 - (b') Effect of sunlight on nodule bacteria.
 - (b) Reaction of soil: acid or alkaline.
 - (a') Effect of acid soil on most legumes.
 - (b') Legumes not injured by acid soil.
 - (c') Correction of soil acidity: kind of lime to use; time and amount to apply; method of applying.
- (7) Per cent of total nitrogen obtained from the air.
- (8) Nitrogen content of root and tops.
- b. Add organic matter when plowed under as green manures.
- c. Act as subsoilers.
- d. Bring up large amounts of plant food from down in the earth and store in stems and leaves.

IV. Sample outline for study of each legume separately.

1. Alfalfa.

- a. History and distribution of alfalfa.
 - (1) Early history and distribution.
 - (2) Introduction into America.
 - (3) Introduction in the United States.
 - (4) Spread in the United States.
 - (5) Spread in Texas.
- b. Study of the alfalfa plant.
 - (1) Stem: structure, size, and height; influence of these factors on quality and yield of hay.
 - (2) Leaves: size, arrangement, and number; influence of leaf surface on quality of hay.
 - (3) Flower: brief study of flower as to number and arrangement of parts.
 - (4) Roots.
 - (a) Kind.
 - (b) Depth of root system.
 - (c) Nodule formation on roots.

- c. Requirements for securing and maintaining a stand.
 - (1) Good seed.
 - (2) Land comparatively free from weeds.
 - (3) Proper soil and soil conditions.
 - (a) Kind, fertility, and reaction of surface soil.
 - (b) Character and depth of subsoil.
 - (c) Drainage.
 - (d) Inoculation.
- d. Place in crop rotation.
- e. Preparation of seed bed.
- f. Time and rate of seeding.
- g. Seeding with a nurse crop or without.
- h. Treatment after seeding and before utilizing crop.
- i. Utilization of crop.
 - (1) For hay.
 - (a) Time to cut.
 - (b) Curing and handling.
 - (a') Injury from rain and sun.
 - (b') Importance of leaves.
 - (c') Hay caps.
 - (2) For green manures.
 - (a) Organic matter helps physical properties of soil.
 - (b) Adds large amount of nitrogen.
 - (3) For soiling.
 - (4) For pasture.
 - (5) For silage.
 - (6) For meal.
 - (7) Growing for seed.
- j. Feeding value as hay; soiling crop; pasturage; silage.
- k. Enemies: weeds; insects; plant diseases; animals.

(This outline with very slight modifications may be used as a guide in the study of each legume. Select only those common to the locality for detailed study.)

E. Grasses.

- I. Varieties of grasses of agricultural importance: timothy; Kentucky blue-grass; Bermuda grass; orchard grass; Johnson grass; red top; brome grasses; meadow fescue; crab grass; carpet grass; velvet grass; foxtail or pigeon grass; Canada blue-grass; Texas blue-grass; buffalo grass; prairie grass; Indian grass; rye-grasses, etc.

II. Value of grasses.

- 1. Food supply of large part of animal life.
- 2. Hold soil and prevent washing and blowing.
- 3. Humus content of soil increased by pasturing, etc.

III. Classification of grasses according to use.

1. Grasses used primarily for hay: timothy, red top, meadow fescue, Johnson grass, Russian brome grass.
2. Grasses used largely for pasture: Kentucky blue-grass, Bermuda, Canadian blue-grass, buffalo grass, carpet grass, and others.
3. Grasses used for both hay and pasture: red top, orchard grass, Bermuda, crab grass, meadow fescue, and others.
4. Lawn grasses: blue grasses, Bermuda grass, buffalo grass.
5. * Grasses best adapted to holding soil.
 - a. Perennials having creeping stems and creeping underground root-stocks.
 - b. All perennials, since they form an extensive network of fibrous roots.

IV. Classification of grasses according to climatic conditions.

1. Grasses best adapted to wet soils: marsh grass, red top, blue-grass, orchard grass, meadow fescue, crab grass, water grass, Bermuda grass.
2. Grasses best adapted to dry soils: prairie grass, buffalo grass, slender wheat grass, brome grass, western rye grass, tall oat grass, Johnson grass.

V. Sowing combination of grass and legume seeds for pastures and meadows.

1. Advantages of mixed pastures and meadows.
 - (1) Gives more continuous grazing in pastures.
 - (2) Yield is larger.
 - (3) Length of life is longer.
 - (4) Yields a better balanced food ration.
2. Combination suited for Texas conditions.
 - (1) Combination for East Texas.
 - (2) Combination for West Texas.

VI. Care of permanent pastures.

VII. Care of permanent meadows.

VIII. Sample outline for study of each grass separately.

1. Name of grass (Bermuda will be used for this outline).
 - a. Native home.
 - b. Early history and distribution.
 - c. Introduction into Texas.
 - d. Present distribution in the United States.
 - e. Present distribution in Texas.
2. Study of the grass plant.
 - a. Stem.
 - (1) Erect, creeping, or prostrate.
 - (2) Structure, size, and length.
 - (3) Influence of these factors on quality and quantity of hay or pasture afforded.

- b. Leaves.
 - (1) Abundant or scanty.
 - (2) Influence of leaf surface on quality of hay.
- c. Flower: brief study of grass flower as to time of flowering, etc.
- d. Roots.
 - (1) Kind of root system.
 - (2) Depth and spread of root system.
- e. Seeds: procure small amount of Bermuda seed and study shape and size of seed; examine closely for impurities.
- f. Methods of reproduction.
 - (1) By seeds.
 - (2) By underground stems.
 - (3) By both roots and seeds.
 - (4) Runners above ground.
 - (5) Cuttings.
3. Requirements for securing and maintaining a stand.
4. Preparation of seed bed.
5. Time and date of seeding.
 - a. Place of procuring seed.
 - b. Cost of seed.
6. Seeding with or without a nurse crop.
7. Planting cuttings of root stocks.
8. Utilization of crop.
 - a. For pasture.
 - (1) Care of pastures.
 - (2) Alternate pasturing as compared with straight pasturing.
 - (3) Number of cattle, sheep, etc., that Bermuda will support per acre.
 - (4) Season of year available for pasture.
 - (5) Comparison of Bermuda with other pasture grasses.
 - b. For hay.
 - (1) Time to cut.
 - (2) Curing and handling.
 - (3) Number of cuttings per season.
 - (4) Quality of hay.
 - (5) Market value of hay.
 - (6) Feeding value as compared with timothy and alfalfa.
9. Hardiness of the crop.
10. Place in crop rotations.

(Select those grasses of local importance for detailed study.)

PRACTICE WORK IN FIELD CROPS.

I. Practice work on corn.

1. Take a pair of scissors and clip out the silks from an ear before pollination. From another ear clip out one-half of the silks. Observe the effect on the two ears.
2. Place a paper bag over the tip of the ear to prevent cross pollination. When the pollen on the stalk is ready to fall gather a quantity of it in a cup, remove the bag and dust the pollen on the silks. Observe the effect of self-pollination.
3. Detassel a few stalks so that there will be no chance for self-fertilization, and compare ears from these stalks with ears from experiment No. 2.
4. Make a study of the root system of corn plants of different ages in the field. Begin on plants two weeks old.
5. Take the class into the field and have them select the seed corn and mark the stalks, giving reasons for their work.
6. Have each student make for himself some kind of device for curing seed corn. Require a neat piece of work.
7. Assuming that it takes one hundred ears to make a bushel of corn, how many bushels can be produced on one acre with the rows three feet eight inches apart each way and one stalk bearing one ear in every hill? With two stalks to the hill? With the stalks eighteen inches apart in drills?
8. Eight average ears of corn will plant an acre, two kernels to the hill, the rows three feet eight inches apart. If a farmer can get a yield of fifty bushels to the acre with a perfect stand, what would be his loss on a forty-acre field if one ear in twenty were very low in vitality?
9. Make tests of seed corn selected from shock, from crib, and from field. Compare the readings of these tests.
10. Procure the leading varieties of corn grown in the State. Fix the type in mind by applying the following outline to a typical ear of each variety:
 - a. Ear.
 - (1) Shape.
 - (2) Length.
 - (3) Circumference one-third of the distance from the butt to the tip.
 - (4) Ratio of circumference to length.
 - (5) Color of grain.
 - (6) Size and color of cob.
 - (7) Number of rows of kernels.
 - (8) Space between rows at tips of kernels.
 - (9) Space between rows at crown of kernels.
 - (10) Space between kernels in the row.

- b. Tips of the ears.
 - (1) Shape.
 - (2) Covered or exposed.
 - (3) Regularity of rows at tip.
 - (4) Size, shape, and depth of kernels.
 - c. Butts of ears.
 - (1) Shape.
 - (2) Regularity of rows.
 - (3) Size, shape, and depth of kernels.
 - (4) Size of shank scar.
 - d. Kernels.
 - (1) Shape.
 - (2) Indentation.
 - (3) Size.
 - (a) Length.
 - (b) Breadth.
 - (c) Thickness.
- 11. Exercise with score card and corn-judging.
 - (1) Using the official score card of the State, score each ear of a ten-ear sample and arrange the ears from left to right in order of the placing on the score card.
 - (2) Score three ten-ear samples, scoring the sample as a whole. Compare your scores with others scoring the same samples.
 - (3) Arrange the ten-ear samples in pairs and have students judge them, giving reason for their placings.
 - (4) Arrange the ten-ear samples in groups of twos and have students judge the groups; then in groups of threes. Require careful work and let the reasons for all placings be recorded neatly in the laboratory notebook.
 - 12. Visit a number of corn fields and find out the time of planting, the kind of cultivation practiced, the system of crop rotation followed, nature of fertilizer used, etc. Have students ask questions and keep notes.
 - 13. If possible to coöperate with county demonstration agent, require students to keep full set of notes on corn work as carried on in demonstration field.
 - 14. Visit corn shows and study the samples and the placing.
 - 15. Continue corn-judging at intervals throughout the course.
 - 16. Run germination tests.
 - 17. Practice ear-to-row tests to improve a strain of corn.
 - 18. Run fertilizer tests and crop rotation tests.

II. Practice work on wheat.

- 1. Using outline maps of the world, have the student indicate the wheat areas of different nations, thus showing the present distribution.

2. Look up in the year books the yield per acre and the total yield from every nation and indicate it on a map. Compare the yields in the United States with each of these.
3. Germination test of large grains and small grains. Plant one hundred large kernels in a box of moist earth and one hundred small kernels in another box. Compare the germination and the health and vigor of the plants of the two.
4. Make drawings of a young wheat plant showing number and arrangement of temporary roots.
5. Make drawings of root system of mature plant showing arrangement of permanent roots.
6. Plant wheat at the following depths: just barely covered, one inch, two inches, three inches, and four inches deep. Record the effects of different depths of planting on germination and general strength of the plants.
7. Study of the wheat flower as to parts, arrangements of parts, time of opening, possibilities of cross fertilization.
8. Procure samples of a few common winter wheats and one spring wheat, in the sheaf. Study each according to the following outline:
 - a. Description of culm or straw.
 - (1) Length.
 - (2) Color.
 - (3) Shape.
 - (4) Appearance: smooth, hairy, rough, grooved.
 - (5) Structure of straw: hollow, partly pithy or solid.
 - b. Description of spike.
 - (1) Length of spike.
 - (2) Number of spikelets.
 - (3) Compactness: open, compact or crowded.
 - (4) Bearded or beardless.
 - (5) Color.
 - c. Description of spikelet.
 - (a) Outer glumes: number, position, length, width, color, hairy or smooth, beaked or notched, thick or thin, keeled or rounded in shape.
 - (b) Lemma: position, shape, color, awned or awnless.
 - (c) Kernels or grain: shape, size, crease, basal brush, texture, number in spikelet, appearance of cross sections.
 - (e) Awns: length, place of attachment, close or spreading.
 - d. Rachis.
 - (1) Appearance of side view.
 - (2) Appearance of edge view.

9. Procure threshed samples of grain and study according to following outline:
 - a. Size of kernel.
 - b. Uniformity of kernels.
 - c. Color of sample.
 - d. Texture: soft, hard or very hard.
 - e. Appearance of cross section: horny or starchy.
 - f. Shape.
 - g. Cheeks: fat, plump or angular.
 - h. Crease: deep, shallow, wide, narrow.
 - i. Brush: large area, small area, long hairs, short hairs.
 - j. Freedom from mixture with other grains.
 - k. Freedom from weed seeds, dirt, broken kernels, etc.
 - l. Freedom from diseased or injured kernels.
 - m. Weight per bushel.
 - n. Milling qualities.
10. Scoring and judging wheat.
 - a. Using the official score card of the State, have students score a few samples and check work with others scoring same samples.
 - b. Have the class judge the samples of winter wheat, giving reasons for their placings.
11. Determination of per cent of loose smut in wheat field and amount of loss due to it. Take a barrel hoop and drop it over its area of wheat. Count the smutty heads. Find the per cent of smutty heads. Make a number of determinations in the field and find the average.
12. Determine the per cent of stinking smut in the same way.
13. Take a quantity of smutty wheat and treat a portion of it with the hot water treatment. Treat another part with formalin. Sow plats from each part of the treated seed and also from the untreated seed. Observe the results the following year.
14. Visit wheat fields within reach of the high school and observe the work being done. Make notes on all field work. Keep a record of the dates of field trips and write up fully in laboratory notebook.

III. Practice work on cotton.

1. Examine cotton plants for characteristics of stem, leaf, root, flower, fruit, etc.
2. Examine types of plants for the high producing, early maturing types. Fix the types preparatory to selecting seed cotton.
3. Examine cotton plants for storm-resisting bolls.
4. Examine several important varieties for distinguishing characteristics of stem, leaf, boll, fiber, seed, etc.
5. Practice frequently cotton classing and use every opportunity to get expert assistance in classing.
6. Visit cotton yards and talk with buyers about the grades of cotton available.

7. Visit a ginnery and examine the machinery and the operations.
8. If possible, visit a cotton-seed oil mill and examine the machinery and observe the operations and products.
9. Practice plant-to-row tests for improving a strain of cotton.
10. Examine cotton plants for diseased or insect-injured plants.

IV. Practice work in legumes.

1. Collect specimens of all the legumes found growing in the community. Study the leaves, leaf arrangement, and flowers.
2. Dig up growing plants of any legumes available, wash the dirt from the roots, and study the nodule formation. Make a few drawings of root systems showing nodules.
3. Examine roots of legumes growing on fertile soils and also on poor soils. Do you find any difference in nodule formation? Is it ever profitable to add nitrogen fertilizers to cowpea and alfalfa fields?
4. Make a careful study of samples of seeds of the following and test each for purity and germination: alfalfa, sweet clover, bur clover, crimson clover, cowpeas, soy beans and vetch. Let each student keep an accurate record of every sample tested and enter it in his permanent notebook. In so far as possible, these seeds should be brought from the homes in the community.
5. Sow four plats of cowpeas or soy beans. Let plat No. 1 be a fertile soil; plat No. 2 a thin soil, to which a liberal amount of barnyard manure has been added; plat No. 3 a thin soil, to which a complete commercial fertilizer has been added at the rate of 300 pounds per acre; plat No. 4 a thin soil, to which nothing has been added. Study as to quality and amount of hay produced, and number and size of nodules on roots.
6. Select an acre of land on the school farm, one, if possible, that is representative of the average lands of the community, uniform in fertility, well drained, comparatively free from weeds. Divide this acre into four plats of equal size. To plat one apply lime at the rate of two tons per acre; to plat two apply the lime at the same rate and inoculate with soil filled with alfalfa bacteria; to plat three add the inoculated soil only; plat four should be given no treatment. Seed to alfalfa and watch the result.
7. Divide another acre of land similar to the one named in exercise 6 into four parts. To plat No 1 apply barnyard manure at the rate of twelve tons (one cord equals one ton) per acre; to plat No. 2 apply lime at the rate of two tons per acre; to plat No. 3 a complete com-

mercial fertilizer at the rate of 300 pounds per acre; to plat No. 4 no treatment. Seed to alfalfa and keep a record of results.

8. Have pupils sow plats of alfalfa, clovers, vetch, soy beans, and cowpeas. They should prepare the seed bed, decide as to the kind and amount of fertilizer to use, inoculation, liming, time of sowing, amount of seed to sow, and should test the seed for purity and germination. Make each student responsible for one particular plat.

9. Problems:

- (1) Calculate the amount of nitrogen taken from the soil in growing a ton of clover hay. If the legume got two-thirds of this from the air and one-third from the soil and left one-third in its roots, how much was the nitrogen content of the soil increased if the hay was removed?
- (2) Calculate the fertilizing value of nitrogen at 20 cents per pound in one ton of alfalfa hay, clover hay, cowpea hay, soy bean hay, oat straw, wheat straw, corn silage, cotton-seed meal, and Johnson grass.
- (3) A farmer bought alfalfa seed, paying \$12 per bushel. The test on this sample showed it to contain 10 per cent dirt, trash, and shrivelled seed; 4.8 per cent weed seed and the germination test was 57 per cent. What was he actually paying for good alfalfa seed?

V. Practice work on grasses.

1. Collect specimens of all the economic grasses found growing in the community. Make drawings of the most important, labeling the culm, leaf sheath, ligule, auricle, blade and roots. Write a brief account of each according to the following outline:
 - a. Name of plant.
 - b. Native home.
 - c. Introduction into Texas.
 - d. Hardiness.
 - e. Annual or perennial.
 - f. Methods of spread.
 - g. Relative value of grass as compared with other grasses for pasture and meadow.
 - h. Description.
 - (1) Culm or stem.
 - (a) Height (average of ten specimens).
 - (b) Position: erect, decumbent, or creeping.
 - (c) Number and arrangement of leaves.
 - (d) Structure of stem: hollow, pithy, or solid.

- (e) Surface: smooth, hairy, rough, or grooved.
- (f) Thickness of wall.
- (g) Number of nodes and distance apart.
- (2) Leaves.
 - (a) Length (average of ten specimens).
 - (b) Width (average of ten specimens).
 - (c) Midrib: prominent, medium, or small.
 - (d) Veins: prominent, medium, or small.
 - (e) Leaf sheath: length and color.
 - (f) Ligule: large or small.
 - (g) Leaf auricle.
- (3) Roots.
 - (a) Kind of roots: stoloniferous or otherwise.
 - (b) Depth and spread of system.
 - (c) Kind of sod formed.
- 2. Procure samples of seed of the grasses studied in exercise No. 1 and test each for purity and germination. Keep a record of each sample tested and record it in the permanent laboratory book. If possible, procure these samples from the seed dealers in your own town.
- 3. Sow small plats of all meadow and pasture grasses that you think will grow in your section of the state and keep a record of the tests. Keep these plats on the school farm for demonstration purposes in so far as it is worth while.
- 4. Preserve specimens of all the grasses studied by gathering when in full bloom. Some of these specimens may be pressed between cardboard and mounted, while others may be cured and bundled into a sheaf. Ricker specimen mounts may be used instead of the cardboard if desirable.
- 5. Keep samples of seeds of all grasses of economic importance and learn to recognize them.

REFERENCE MATERIAL IN FIELD CROPS.

I. Minimum.

- 1. Duggar: Southern Field Crops (Macmillan Co., Dallas), \$1.75.
- 2. Hunt: Cereals in America (Orange Judd Co., New York), \$1.75.
- 3. Hunt: Forage and Fiber Crops in America (Orange Judd Co., New York), \$1.75.
- 4. Miller: American Cotton System (Austin Printing Company, Austin, Texas), \$1.50.

II. Other books desirable.

1. Bowman & Crossley: Corn (Kenyon Printing Company, Ames, Iowa), \$2.00.
2. Burkett: Farm Crops (Orange Judd Co., New York), \$1.50.
3. Burkett and Poe: Cotton (Doubleday, Page & Co., Garden City, N. Y.), \$2.00.
4. Coburn: Book of Alfalfa (Orange Judd Co., New York), \$2.00.
5. Curtiss: Wheat Culture (Orange Judd Co., New York), 50c.
6. Dodlinger: Book of Wheat (Orange Judd Co., New York), \$2.00.
7. Livingston: Field Crop Production (Macmillan Co., Dallas), \$1.00.
8. Myrick: Book of Corn (Orange Judd Co., New York), \$1.50.
9. Plumb: Corn Culture (Sanders Pub. Co., Chicago), \$1.00.
10. Sevey: Peas and Pea Culture (Orange Judd Co., New York), 50c.
11. Shaw: Forage Crops Other Than Grasses (Orange Judd Co., New York), \$1.00.
12. Shaw: Grasses and How to Grow Them (Webb Pub. Co., St. Paul), \$1.50.
13. Shamel: Manual of Corn Judging (Orange Judd Co., New York), 50c.
14. Shoesmith: Study of Corn (Orange Judd Co., New York), 50c.
15. Spillman: Farm Grasses of the United States (Orange Judd Co., New York), \$1.00.
16. Voorhees: Forage Crops (Macmillan Co., Dallas), \$1.50.
17. Wilson & Warburton: Field Crops (Webb Pub. Co., St. Paul), \$1.50.
18. Wing: Alfalfa Farming in America (Sanders Pub. Co., Chicago, Ill.), \$2.00.
19. Wing: Meadows and Pastures (Sanders Pub. Co., Chicago), \$1.50.

III. Bulletins and other publications.

1. Bulletin No. 175: Grasses (Kansas Experiment Station, Manhattan).
2. Bulletin No. 176: How to Grow Wheat in Kansas (Kansas Experiment Station, Manhattan).
3. Bulletin No. 225: Farm Grasses of Ohio (Ohio Experiment Station, Wooster).
4. Bulletin No. 110: Corn Improvement (Purdue Experiment Station, Lafayette, Ind.)
5. Bulletin No. 47: Corn Improvement (Michigan Experiment Station, East Lansing, Mich.).

6. Bulletin No. 199: Cowpeas, Soy Beans, and Winter Vetch (Michigan Experiment Station, East Lansing).
7. Bulletin No. 224: Influence of Nodules on Roots Upon Composition of Soy Beans and Cowpeas (Michigan Experiment Station, East Lansing).
8. Bulletin No. 268: Wheat Improvement (Michigan Experiment Station, East Lansing, Mich.).
9. Bulletin No. 11: Wheat and Oats (Wisconsin Experiment Station, Madison).
10. Bulletin No. 160: The Soy Bean and Cowpea (Ohio Experiment Station, Wooster).
11. Bulletin No. 108: Winter Bur Clover (Texas Experiment Station, College Station).
12. Bulletin No. 132: Coöperative Forage Crop Work (Texas Experiment Station, College Station).
13. Bulletin No. 137: Alfalfa in Northwest Texas (Texas Experiment Station, College Station).
14. Bulletin No. 20: Some Especially Valuable Grasses in Texas (State Dept. of Agriculture, Austin).

Bulletins of the Bureau of Plant Industry, Washington, D. C.

15. Bulletin No. 58: Vitality and Germination of Seed.
16. Bulletin No. 59: Pasture, Meadow, and Forage Crops in Nebraska.
17. Bulletin No. 83: Vitality of Buried Seeds.
18. Bulletin No. 152: Loose Smuts of Barley and Wheat.
19. Bulletin No. 256: Heredity and Cotton Breeding.
20. Bulletin No. 257: Weed Factor in Cultivation of Corn.
21. Bulletin No. 283: Cereal Experiment in Texas Panhandle.

Circulars of the Bureau of Plant Industry, Washington, D. C.

22. Circular No. 8: Smuts of Sorghums.
23. Circular No. 11: Danger in Judging Cotton Varieties by Lint Percentages.
24. Circular No. 12: Dry Land Grains.
25. Circular No. 14: Change in Vegetation in South Texas Prairies.
26. Circular No. 30: Improvement of Oat Crop.
27. Circular No. 50: Three Much Misrepresented Sorghums.

Farmers' Bulletins, Division of Publications, Washington, D. C.

28. Bulletin No. 81: Corn Culture in the South.
29. Bulletin No. 164: Rape as Forage Crop.
30. Bulletin No. 189: Information Concerning Mexican Cotton Boll Weevil.
31. Bulletin No. 229: Production of Good Seed Corn.
32. Bulletin No. 246: Saccharine Sorghums for Forage.
33. Bulletin No. 250: Prevention of Stinking Smut of Wheat and Loose Smut of Oats.
34. Bulletin No. 253: Germination of Seed Corn.

35. Bulletin No. 260: Seed of Red Clover and Its Impurities.
36. Bulletin No. 272: Successful Hog and Seed Corn Farm.
37. Bulletin No. 279: Method of Eradicating Johnson Grass.
38. Bulletin No. 288: Non-saccharine Sorghums.
39. Bulletin No. 290: Cotton Boll Worm; Summary of Its Life History and Habits.
40. Bulletin No. 300: Some Important Grasses and Forage Plants for Gulf Coast Region.
41. Bulletin No. 302: Sea Island Cotton; Its Culture, Improvement, and Diseases.
42. Bulletin No. 306: Dodder in Relation to Farm Seeds.
43. Bulletin No. 312: Successful Southern Hay Farm.
44. Bulletin No. 313: Harvesting and Storing Corn.
45. Bulletin No. 314: Method of Breeding Early Cotton to Escape Boll Weevil Damage.
46. Bulletin No. 315: Progress in Legume Inoculation.
47. Bulletin No. 318: Cowpeas.
48. Bulletin No. 322: Milo as a Dry Land Grain Crop.
49. Bulletin No. 331: Forage Crops for Hogs in Kansas and Oklahoma.
50. Bulletin No. 333: Cotton Wilt.
51. Bulletin No. 339: Alfalfa.
52. Bulletin No. 362: Conditions Affecting Value of Market Hay.
53. Bulletin No. 382: Adulteration of Forage Plant Seeds.
54. Bulletin No. 400: More Profitable Corn Planting Method.
55. Bulletin No. 409: School Lessons on Corn.
56. Bulletin No. 414: Corn Cultivation.
57. Bulletin No. 415: Seed Corn.
58. Bulletin No. 417: Rice Culture.
59. Bulletin No. 420: Oats, Distribution and Use.
60. Bulletin No. 426: Oats; Growing the Crop.
61. Bulletin No. 427: Barley Culture in Southern States.
62. Bulletin No. 428: Testing Farm Seeds in Home and in Rural School.
63. Bulletin No. 431: Peanut.
64. Bulletin No. 436: Winter Oats for the South.
65. Bulletin No. 441: Lespedeza or Japan Clover.
66. Bulletin No. 443: Barley; Growing the Crop.
67. Bulletin No. 446: Choice of Crops for Alkali Lands.
68. Bulletin No. 448: Better Grain Sorghum Crops.
69. Bulletin No. 458: Best Two Sweet Sorghums for Forage.
70. Bulletin No. 485: Sweet Clover.
71. Bulletin No. 495: Alfalfa Seed Production.
72. Bulletin No. 500: Control of Boll Weevil.
73. Bulletin No. 501: Cotton Improvement Under Boll Weevil Conditions.
74. Bulletin No. 507: Smuts of Wheat, Oats, Barley, and Corn.
75. Bulletin No. 508: Market Hay.

76. Bulletin No. 509: Forage Crops for Cotton Region.
77. Bulletin No. 512: Boll Weevil Problem with Special Reference to Means of Reducing Damage.
78. Bulletin No. 515: Vetches, with Chapter on Vetch Seed and Its Adulterants.
79. Bulletin No. 518: Winter Barley.
80. Bulletin No. 529: Vetch Growing in South Atlantic States.
81. Bulletin No. 537: How to Grow an Acre of Corn.

FRUIT PRODUCTION.

I. Introduction.

1. List of fruits grown in the United States.
2. Area for growing each species.
3. List of fruits grown in Texas.
4. Area of growth of each.
5. Value of nation's fruit crop, and Texas crop.

II. Factors determining fruit growing.

1. Temperature.

- (1) Classes of fruit as determined by temperature.
 - a. Tropical. (List in Texas.)
 - b. Subtropical. (List in Texas.)
 - c. Temperate. (List in Texas.)
- (2) Factors controlling annual temperature.
 - a. Altitude.
 - b. Latitude.
 - c. Nearness to water.

2. Moisture.

- (1) Soil moisture.
 - a. Effect of excess.
 - b. Effect of deficiency.
- (2) Atmospheric moisture; its effect on
 - a. Temperature.
 - b. Pollinization.
 - c. Development of fungus diseases.
 - d. Development of color.

3. Soil.

- (1) Preference of certain fruits for certain soils.
- (2) Character of subsoil.
 - a. Necessity of pervious subsoil.
 - b. Disadvantage of extremely rich subsoil.

4. Insect enemies and fungus diseases. (See page 139.)

- (1) List of most common insect enemies of fruit.
- (2) List of most common fungus diseases of fruit.
- (3) Methods of control.

III. Factors to be considered in locating a commercial fruit farm.

1. Market.

(1) Local.

- a. Must be large enough to consume product.
- b. Necessity of good roads.
- c. Soil should grow a variety of fruits.
- d. Should be able to ripen varieties all through the summer season.
- e. Labor problem.

- (2) Wholesale.
 - a. Transportation,—railroad facilities.
 - b. Soil adapted to special fruits.
 - c. Labor problem.
- 2. Soil.
 - (1) Kind of fruit to be grown.
 - (2) Character of the subsoil.
 - (3) Drainage.
- 3. Orchard site.
 - (1) Elevation.
 - a. Land drainage.
 - b. Air drainage.
 - (2) Exposure: depends on.
 - a. Local conditions.
 - b. Kind of fruit to be grown.

IV. Factors to be considered in locating the home orchard.

- 1. Convenience to farm house.
- 2. Character of the soil and subsoil.
- 3. Exposure.
- 4. Elevation.

V. Preparation of soil for planting.

- 1. Grow clean culture crops one or two years before planting.
- 2. Loosen soil deeply, sixteen to twenty inches.
- 3. Make cultivation clean and thorough.

VI. Laying out the orchard.

- 1. Methods of laying out.
 - (1) Laying out with plow.
 - (2) Line methods.
 - (3) Staking methods.
- 2. Orchard plans.
 - (1) The hexagonal plan.
 - (2) The alternate plan.
 - (3) The Olden plan.
 - (4) The Parker plan.
 - (5) The Hale system.
- 3. Double planting.
 - (1) Advantages and disadvantages.
 - (2) Dangers of double planting.

VII. Selecting young trees for planting.

- 1. Age to plant: depends on
 - (1) Variety of fruit.
 - (2) Cost of plants.
 - (3) Use to be made of fruit.
 - (4) Skill of orchardist in handling young trees.
- 2. Reason for use of young trees.
 - (1) Young trees suffer but little shock in transplanting.
 - (2) Older trees are liable to be culls.

3. Select well shaped, clean, healthy trees, free from injury or disease with abundant root system and three to five well distributed branches headed out at proper height from ground.
4. Providing for cross pollination.

VIII. Planting.

1. Digging the holes.
 - (1) Size and depth necessary.
 - (2) Digging with dynamite.
2. Root pruning.
3. Depth of planting.
4. Effect of placing manure or fertilizers in the hole.
5. Use of planting board.
6. Slanting trees in regions of strong prevailing winds.

IX. Care of the young orchard.

1. Pruning the young trees.
 - (1) Pruning the one-year-old tree for head at proper height.
 - (2) Pruning trees up to bearing age.
2. Necessity of spraying.
3. Cultivation.
 - (1) Cropping the young orchard.
 - a. Advantages.
 - b. Disadvantages.
 - (2) Growing small fruits between the trees.
 - (3) Clean cultivation without a crop.
 - (4) Use of cover crop to mature trees early.

X. Care of bearing orchard.

1. Orchard soil management.
 - (1) Orchard cropping.
 - a. Crops that do the least damage.
 - b. Crops that are especially injurious.
 - (2) Sod mulch system.
 - a. Advantages.
 - (a) Has tendency to mature fruit earlier.
 - (b) Tends to heighten color.
 - (c) Reduces fire blight.
 - (d) Prevents washing.
 - b. Disadvantages.
 - (a) Brings roots near surface, subjecting them to heat and cold.
 - (b) Harbor for diseases and rodents.
 - (c) Reduces soil moisture.
 - (d) Fruit is smaller.
 - (e) Growth of tree is less.
 - (f) Danger of fire.
 - c. Where practiced.

- d. Climatic conditions necessary to make it succeed.
 - e. General care of orchard under sod mulch system.
 - (3) Clean culture with a cover crop.
 - a. Time to begin cultivating.
 - b. Frequency of cultivation: depends on.
 - (a) Kind of soil.
 - (b) Amount of rainfall.
 - c. Depth of cultivation.
 - d. Time to sow the cover crop.
 - e. Kind of cover to sow.
 - f. Purpose of cover crop.
 - (4) Clean culture without a cover crop.
- 2. Orchard fertilization.
 - (1) Purpose of fertilizing.
 - (2) Time to fertilize.
 - (3) Kind of fertilizer to apply.
 - (4) Results of experiments on orchard fertilization..
- 3. Pruning.
 - (1) Purposes of pruning.
 - a. Welfare of the plant itself.
 - b. Increases size and vigor of tree.
 - c. Increases amount, size, and quality of fruit.
 - d. Removes worthless branches and water sprouts.
 - e. Changes plant from wood to fruit-bearing habits.
 - f. To keep heads of trees open.
 - g. To shape the trees and facilitate orchard operations.
 - (2) Time to prune: determined in part by
 - a. Purpose of pruning.
 - b. Climatic conditions.
 - (3) Factors influencing the healing of wounds.
 - a. General vigor of plant.
 - b. Method of making cuts.
 - c. Climatic conditions.
 - d. Season at which the cut is made.
 - e. Place of making the cut.
 - f. Size of cut.
 - g. Care of the wound.
 - (4) Methods of pruning.
 - (5) Tools for pruning.
- 4. Spraying.
 - (1) Purposes of spraying.
 - a. To control insect pests.
 - b. To control fungus diseases.
 - (2) Sprays used as fungicides.

- (3) Sprays used as insecticides.
 - a. Sprays for sucking insects.
 - b. Sprays for biting insects.
- (4) Combined spray for fungus and insect pests.
- (5) Time to spray.
- (6) Number of applications.
- (7) Formulae for mixing sprays.
- (8) Spraying machinery.
5. Protection from frosts and freezes.
 - (1) Smudges.
 - (2) Orchard heating.
 - a. Kind of heater.
 - b. Kind of fuel to use.
 - c. Size of heater, number to use per acre.
 - d. Operating heaters.
 - e. Cost per acre per night.
 - f. Necessity for understanding weather conditions. Frost alarms.
 - g. Temperatures at which different fruits are injured by frost.
 - (3) Covering trees with tents and burning lantern or stove under tent.
 - (4) Straw mulches and other coverings for small fruits.

XI. Renovating old orchards.

1. Factors determining the advisability of renovating:
 - (1) Age and vigor of trees.
 - (2) Varieties of fruit grown and quality.
 - (3) Site.
 - (4) Size of the orchard.
2. Methods of renovating.
 - (1) Pruning.
 - (2) Grafting.
 - (3) Cultivation.
 - (4) Fertilizing.
 - (5) Spraying.

XII. Harvesting and marketing.

1. Time to pick: depends on
 - (1) Kind of fruit.
 - (2) Distance from market.
 - (3) Kind of market.
 - (4) Use to be made of fruit.
2. How to gather fruit.
 - (1) Necessity of hand picking.
 - (2) Use of ladders in picking tree fruits.
 - (3) Use of baskets instead of bags for tree fruits.
 - (4) Picking baskets and boxes for small fruits.

3. Fruit packages and fruit packing.
 - (1) Requisites of good packing.
 - a. Must ship well.
 - b. Must be attractive.
 - c. Should be uniform in size.
 - (2) Fundamental principles of fruit packing.
 - (3) Packing equipment.
 - (4) Packing house.
 - (5) Methods of packing.
4. Houses for storing fruit.
5. Marketing.
 - (1) Precooling.
 - (2) Refrigerator cars for shipping.
 - (3) Marketing associations.
 - (4) Commission merchants.
 - (5) Market prices and cost of marketing.

XIII. Abbreviated inventory of fruits.

1. Pome fruits: apples, pears, quinces.
2. Stone fruits: plums, cherries, peaches, nectarines, apricots.
3. Citrus fruits: oranges, tangerines, satsumas, lemons, limes, grape fruits.
4. Bush fruits: raspberry, blackberry, gooseberry, dewberry, currant.
5. Vine fruits: grapes.
6. Strawberries.
7. Nut fruits: walnut, butternut, chestnut, hickory nut, filbert, almond, pecan, pistacio.
8. Figs.
9. Persimmons.

XIV. Brief outline for the study of each sub-class listed.

1. Region of growth in the United States.
2. Area adapted to growth in Texas.
3. Average annual production in Texas.
4. Varieties adapted to Texas conditions.
5. Soils best suited to growth.
6. Exposure most desirable.
7. Methods of propagating.
8. Production of new varieties.
9. Habit of growth.
10. Preparation of land for planting.
11. Laying out for planting.
12. Distance apart to plant.
13. Age of plants to use.
14. Cultivation.
15. Protecting from rodents.
16. Pruning and training.
17. Insect pests and fungus diseases of both fruit and tree.
18. Spraying.

19. Protection from frost.
20. Picking, packing, and marketing.
21. Utilization.

(Stress fruits of local interest and pass over briefly, or omit, others according to time available.)

PRACTICE WORK IN FRUIT PRODUCTION.

1. Grafting. Procure roots and cions for root grafting. It is best to grow the root stocks on the school garden and have the students care for them. The cions may be taken from any good fruit tree in the neighborhood and kept in good condition until time for use. Make a number of whip grafts, veneer grafts, etc. Wrap with waxed cloth, paper, or twine and pack away in moist sand or moist sawdust until planting time.
2. Grafting. Do some work in the laboratory in side- and cleft-grafting. After learning the fundamentals of both and after enough work has been done to make the students fairly proficient, take them to a pecan or apple tree that needs top working and have them make a number of cleft-grafts on desirable limbs. Also have them make some side-grafts on young pecan or apple seedlings.
3. Preparation of grafting wax. A grade of wax that will answer all purposes may be made by melting together four ounces of rosin, two ounces of beeswax, and one ounce of tallow. When melted, pour into a pail of cold water, let it stand until it can be handled, and then pull until it becomes light in color and pliable. Make into balls and store for use.
4. Preparing waxed string. Put a ball of No. 18 knitting cotton into a kettle of melted wax. Turn it frequently until it is thoroughly saturated. This should require about five minutes. Remove the ball, dry it and store away for future use.
5. Preparing waxed cloth. Take some thin muslin or old calico, roll on a stick, and dip it in melted wax. When thoroughly saturated allow it to cool by unrolling on a board or bench. Cut into strips of suitable width and length and save for use.
6. Planting. Plant the grafts prepared in exercise 1 and keep record of the number of whip-grafts that live, the number of veneer-grafts that live, etc. Compare the efficiency of the systems.
7. Cutting. Take cuttings from the ripened wood of the grape, blackberry, dewberry, and fig. These should be made from six to ten inches long with a bud close to the lower end and another about one-half inch or one inch from the top. The number of buds on the cutting will range from three on the grape to as many as sixteen or eighteen on the currant. These may be planted when taken but it is better to bundle them and store them away in moist sand in a cool cellar or bury them in the earth until planting time, when they should be planted in a trench dug for that purpose and not stuck in the earth.

8. Layering. Grapes, raspberries, dewberries, currants and gooseberries are frequently propagated by layering. Have the students propagate
 1. A choice variety of grape in the neighborhood by digging a trench near the vine, bending a cane down to the ground and burying it in the trench two or three inches deep, leaving the tip of the cane exposed.
 2. Dewberries by tip layering.
9. Budding. Use willows or any other tree plant on which the bark slips readily for exercises in shield and ring-budding. After the class has learned to do a neat, clean piece of budding and do it fairly rapidly, take them out to the school farm and let them bud some peach and pecan seedlings. Also give them a lesson in top-budding pecan trees.
10. Exercise in laying out fruit farm or orchard. Using any of the methods commonly used for laying out the fruit farm, plan an orchard on the school farm and stake it out accurately. Make the exercise such that each student gets practice in laying out the fruit farm. Do not accept the work until it is done accurately.
11. Planting. This exercise should consist in digging holes with a shovel; digging with dynamite; the use of the planting board, and planting the trees. The students should not be allowed to handle the dynamite at all. The teacher should give the demonstration but should not assume the responsibility of having the students handle it.
12. Pruning and training. After giving the class-room work in pruning and training, have the students do some work in root pruning of young stock for transplanting; pruning of young trees; pruning of bush fruits; and pruning and training grapes. If material for this is not available on the school farm, go into the orchards and vineyards in the community and do some community work.
13. Preparation of sprays. Prepare arsenate of lead, Bordeaux mixture, lime sulphur, and Paris green sprays according to directions found in the new series, bulletin No. 9, prepared by the State Department of Agriculture at Austin.
14. Spraying. Buy a barrel spray pump and spray all fruits grown on the school farm. Be sure that the children do this work intelligently. They should know exactly what they are spraying for, and should have a spray calendar telling them when to spray. Have students keep a complete record of all work. It is a good policy to leave a few trees in the orchard unsprayed and compare the amount and quality of fruit grown on the unsprayed and the sprayed tree.
15. Picking and packing. If any fruit ripens in the community during this course, observe the methods of picking and packing for market. If this is not feasible, visit wholesale or retail houses and observe there the methods of packing for local market and

packing for shipping. As soon as fruit can be grown on the school farm, have the students gather and prepare it for market in the neatest and most attractive manner they can devise.

16. Diseases and insect enemies of fruits. Procure as many specimens of diseased and faulty fruits as possible from the homes of the students and from the local markets. Study the cause of each and methods of control.
17. Bring into the laboratory as many different varieties of apples, pears, peaches, grapes, strawberries, etc., as may be obtained, and have students identify and compare the different varieties of each. Let them study a few varieties according to the outlines found in Waugh's "Systematic Pomology" and elsewhere and then judge them, giving first, second and third places on the first, second and third varieties respectively. If time will permit they may be allowed to place the samples in the variety also.

REFERENCE MATERIAL IN FRUIT PRODUCTION.

I. Minimum.

1. Bailey: Nursery Book (Macmillan Co., Dallas), \$1.50.
2. Bailey: Pruning Book (Macmillan Co., Dallas), \$1.50.
3. Card: Bush Fruits (Macmillan Co., Dallas), \$1.50.
4. Lodeman. The Spraying of Plants (Macmillan Co., Dallas), \$1.25.
5. Paddock & Whipple: Fruit Growing in Arid Regions (Macmillan Co., Dallas), \$1.50.
6. Waugh: American Apple Orchard (Orange Judd Co., New York), \$1.00.

II. Other books desirable.

1. Bailey: Principles of Fruit Growing (Macmillan Co., Dallas), \$1.50.
2. Bailey: Cyclopedia of Horticulture (Macmillan Co., Dallas), in press.
3. Duggar: Fungous Diseases of Plants (Ginn & Co., Dallas), \$2.00.
4. Fuller: Grape Culturist (Orange Judd Co., New York), \$1.50.
5. Fuller: Nut Culturist (Orange Judd Co., New York), \$1.50.
6. Green: Popular Fruit Growing (Webb Publishing Co., St. Paul), \$1.00.
7. Hume: Citrus Fruits and Their Culture (Orange Judd Co., New York), \$2.50.
8. Kains: Making Horticulture Pay (Orange Judd Co., New York), \$1.50.
9. Munson: Foundation of American Grape Culture (Orange Judd Co., New York), \$3.00.
10. Thomas: American Fruit Culturist (Orange Judd Co., New York), \$2.50.

11. Waugh: American Peach Orchard (Orange Judd Co., New York), \$1.00.
12. Waugh: Fruit Harvesting, Marketing, Storing (Orange Judd Co., New York), \$1.00.
13. Waugh: Plums and Plum Culture (Orange Judd Co., New York), \$1.50.

III. Bulletins and other publications.

1. Bulletin No. 113: Spray Calendar (Texas Experiment Station, College Station, Texas).
2. Bulletin No. 124: The Pecan Case Borer (Texas Experiment Station, College Station, Texas).
3. Bulletin No. 148: Report on Experiments with Citrus Fruits at the Beeville Sub-station (Texas Experiment Station, College Station).
4. Bulletin No. 3 (New Series): Citrus Fruits in Texas (State Dept. of Agriculture, Austin).
5. Bulletin No. 19: The Pecan and Hickory in Texas (State Dept. of Agriculture, Austin).
6. Bulletin No. 118: How to Control San Jose Scale and Other Orchard Pests (Purdue Experiment Station, Lafayette, Ind.).
7. Bulletin No. 262: Suggestions on Planting Orchards (Michigan Experiment Station, East Lansing).
8. Bulletin No. 232: Spray Calendar (Ohio Experiment Station, Wooster).
9. Bulletin No. 55: Pruning Peach Trees (Missouri Experiment Station, Columbia, Mo.).
10. Bulletin No. 30: Budding Pecans (Bureau of Plant Industry, Washington).
11. Bulletin No. 251: Pecan (Bureau of Plant Industry, Washington, D. C.).
12. Circular No. 35: Protecting Orchards Against Frosts and Freezes (Missouri Experiment Station, Columbia).
13. Circular No. 31: Hardiness of Peach Buds, Blossoms, and Young Fruit as Influenced by the Care of the Orchard (Missouri Experiment Station, Columbia).
14. Circular No. 17: The Farmer's Orchard (Purdue Experiment Station, Lafayette, Ind.).

Farmers' Bulletins, Division of Publications, Washington, D. C.:

15. Bulletin No. 17: Peach Yellows and Peach Rosette.
16. Bulletin No. 104: Notes on Frosts.
17. Bulletin No. 113: The Apple and How to Grow It.
18. Bulletin No. 118: Grape Growing in the South.
19. Bulletin No. 154: Home Fruit Garden, Preparation and Care.
20. Bulletin No. 172: Scale Insects and Mites on Citrus Trees.
21. Bulletin No. 181: Pruning.
22. Bulletin No. 198: Strawberries.

23. Bulletin No. 213: Raspberries.
24. Bulletin No. 238: Citrus Fruit Growing in the Gulf States.
25. Bulletin No. 243: Fungicides and Their Use in Preventing Diseases of Fruits.
26. Bulletin No. 283: Spraying for Apple Diseases and Codling Moth in the Ozarks.
27. Bulletin No. 284: Insect and Fungous Enemies of Grape East of Rocky Mountains.
28. Bulletin No. 293: Use of Fruit as Food.
29. Bulletin No. 471: Grape Propagation, Pruning and Training.
30. Bulletin No. 538: Sites, Soils, and Varieties for Citrus Groves in Gulf States.

FARM MECHANICS, FARM MANAGEMENT, AND HOME GROUNDS.

A. Farm mechanics.

I. Farm machinery.

1. Introduction.

Evolution of farm machinery; effect upon price of labor and of product; effect upon occupation of farming; demand for skilled labor; effect upon length of working day; effect upon labor of women; effect upon quality of product.

2. Definitions and principles of mechanics.

Force; work; foot-pound and horse-power; power; machine; lever; inclined plane; screw; pulley.

3. Transmission of power.

Belting: leather, rubber, canvas, chain; gearing: rope, cable.

4. Classification of farm machinery.

(1) Tillage machinery.

a. Plows: walking; sulky; gang; jointer; hillside; subsoil; disk.

b. Harrows: smoothing harrows; spring tooth; curved knife-toothed; disk,—full disk, cutaway, spading, orchard.

c. Rollers: log; smooth iron; corrugated; sub-surface packer.

d. Planker.

e. Cultivators: walking,—tongue, tongueless; riding,—single row, double row; shovel, disk, surface; one-horse, two-horse, three-horse, etc.

f. Planting and seeding machinery.

(a) Seeders: hand seeders; wheelbarrow; end gate; wheeled broadcast, etc.

(b) Drills: hoe; shoe; single-disk; double-disk; press drill; one-horse drill, etc.

(c) Planters: cotton, corn, potatoes, etc.; drill and check; one-row and two-row; hand planters and horse planters; listers.

g. Harvesting machinery: mowers; grain binders; corn binders; cotton pickers; loaders; tedders; hay forks; baling presses; potato diggers, etc.

h. Power machinery: windmills; tread mills; jack screws; windlass; sweep;

block and tackle; water wheel; water ram; oil engines; steam engines, etc.

- i. Other machinery: threshing machines; sprayers; fans; feed grinders; silage cutters; manure spreaders; pumps, etc.

5. General outline for study of more important machines.

- (1) Evolution.
- (2) Construction.
- (3) Function and efficiency.
- (4) Operation and adjustment.
- (5) Adaptability to farm conditions.
- (6) Care.
- (7) Cost.

II. Drainage.

1. Lands requiring drainage.

Lands containing basins; "seepy" lands; flat lands underlaid with impervious layer; lands subject to overflow; rice lands, etc.

2. Effect of drainage on

Soil texture; temperature; amount of air; depth of roots; drouth resistance; surface wash, etc.

3. Kinds of drainage.

- (1) Open ditches: advantages and disadvantages.
- (2) Underdrains: advantages and disadvantages.

4. Tile drainage.

- (1) Preliminary survey: importance; methods, maps.
- (2) Laying out the drainage system: direction of drains; depth; distance apart; system of lines; staking out drains.
- (3) Leveling and grading tile drains: taking levels; establishing the grade; figuring the cuts.
- (4) Laying the tile: digging the ditch to grade; placing the tiles; filling the ditch.
- (5) Cost: tiling; digging; laying; filling.

III. Farm buildings.

1. Location, factors influencing: convenience; soil conditions; water supply; drainage, etc.

2. Materials of construction: wood, brick, stone, concrete, etc.

3. Plans for buildings, cost, etc.

Farm house; barn; dairy barn; poultry house; hog houses; silo; implement house; shop, etc.

IV. Farm terracing. (Civil Engineering Bulletin No. 2, A. and M. College of Texas.)

1. Importance of terracing: prevents erosion; conservation of rainfall.

2. Methods of terracing.

- (1) Guide row terraces.

(2) Level bench terraces.

(3) Mangham terraces.

V. Repair of farm equipment.

Harness; belting; binder canvas; woodwork, etc.

VI. Use of concrete on the farm.

1. Cement: nature and manufacture.

2. Making of concrete.

Amounts of cement, gravel, sand; mixing; handling.

3. Forms for concrete.

Building; filling; reinforcing.

4. Uses of concrete.

Walks; troughs; posts; steps; floors; foundations; silos, etc.

5. Efficiency, permanence, and cost.

VII. Rope work.

Knots; splices; halters, etc.

B. Farm management.

I. Introduction.

Primitive agriculture; British agriculture; American agriculture; changes in types of farming and development markets; need of organization.

II. Definition.

Farm management; capital; inventory; farm receipts; farm expenditures; farm income; labor income.

III. Business side of farming.

1. Farming as a business.

Complex problems; need for broad scientific training; need for business principles.

2. Farm accounting.

(1) Inventory: object, how and when to take.

(2) Accounts.

a. Accounts with persons or firms: object, method of keeping.

b. Accounts with crops, animals, etc.: object of cost accounts; items with which crops must be charged and credited; items with which animals must be charged and credited.

c. Interpretation of results.

(3) Distribution of labor cost: horse; man.

(4) Business statement.

3. Factors of production.

(1) Capital.

Fixed or circulating; relation of capital to profit; proportion in real estate; propor-

tion in machinery; proportion in live stock; cost of motive power; relation of capital to type of farming; ways of securing capital; demand for greater capital than formerly; ways of starting with small capital.

(2) Land.

- a. Nature of soil: soil type, fertility, contour, drainage, etc.
- b. Proportion of waste land.
- c. Land tenure.

(a) Ownership: advantages and risks.

(b) Land rental: cash, share, specified rent and cropping system; advantages and disadvantages.

(3) Labor.

- a. Cost of labor.

(a) Man labor: why labor is scarce; cost per day, month, year; profit sharing; improved machinery versus farm labor.

(b) Horse labor.

Cost per day; ways of saving cost of horse labor; amount a horse should do.

(c) Power: fuel, labor, etc.

- b. Direction of labor: by employee, foreman, superintendent.

- c. Method of caring for farm labor: shelter, board, etc.

IV. Types of farming classified.

1. As to maintenance of fertility: exploitive, etc.
2. As to extent and method: intensive and extensive.
3. As to diversity of crops: single crop farming, dominant crop farming, diversified farming.
4. As to source of income: grain farming, truck farming, fruit farming, poultry farming, etc.

V. Comparison of systems of farming.

1. Types to be studied: grain farming, dairy farming, live stock farming, cotton farming, mixed farming, etc.
2. General outline for study of each.
 - (1) Influence of climate, soil and topography.
 - (2) Influence of supply and market demand.
 - (3) Influence of transportation facilities.
 - (4) Influence of land values.
 - (5) Influence of amount of capital.

- (6) Influence of supply of labor.
- (7) Influence of repressive agencies: weeds, insects, diseases, etc.
- (8) Influence of types of farming in neighborhood.
- (9) Influence of personal factor.

VI. Choosing a farm: factors influencing.

1. Location.

(1) Surroundings.

Healthfulness; climate; neighbors; markets; schools; churches; social centers; mail delivery; telephone, etc.

(2) Character of the farm.

a. Nature of the soil.

Soil type, fertility, drainage.

b. Proportion of waste land.

c. Improvements:

(a) Kinds: houses, barns, silos, fences, etc.

(b) Condition and value.

(c) Location and arrangement.

d. Water supply.

e. Orchards, pastures, woodland, etc.

f. Size of the farm.

VII. Planning the farm.

Need for planning; location of farmstead; access to fields, number of fields; replanning a farm for profit,—original plan, transitional plan, permanent plan; crop ledger plan; past treatment.

VIII. Crops and crop rotation.

1. Reasons for crop rotation.

(1) Helps to control weeds, insects, diseases, etc.

(2) Gives opportunity to add humus.

(3) Makes opportunity for legumes.

(4) May save labor.

(5) May keep land occupied longer.

(6) Allows alternation of deep and shallow feeding crops.

(7) Provides for balanced removal of plant food.

(8) Systematizes farming.

2. Characteristics of a good cropping system.

(1) Area of each crop should be nearly the same each year.

(2) Should provide roughage and pasture.

(3) Should include at least one tilled crop to kill weeds.

(4) Should include a sod.

(5) Should maintain humus content.

(6) Should provide well for the cash crop.

3. Relation between crop rotation and type of farming.
4. Use of more than one rotation on the farm.
5. Suitable rotations for local conditions.
6. Change of rotation due to crop failure.

IX. Farm equipment.

Duty of machinery; cost; depreciation; what machinery to buy.

X. Marketing farm products.

1. Time to sell.
Cost of holding; shrinkage and depreciation; prices in different months.
2. Ways of selling.
Retail; wholesale; commission; auction.
3. Preparation of product for market.
Fitting stock; preparation of hay, grain, cotton, etc.; packages and condition of fruit, truck, eggs, butter, etc.

C. Improvement of home grounds. (See pages 133-137.)

PRACTICE WORK IN FARM MECHANICS, FARM MANAGEMENT, AND HOME GROUNDS.

I. Practice work in farm mechanics.

1. Study various kinds of farm machinery. This machinery may be found at the implement stores, and practice may be had in setting it up.
2. Visit farms and list machinery. Observe the care and storage. Inquire of the cost, expenditure for repairs, etc. Estimate amount invested in machinery.
3. In so far as it is practicable observe the operation of the various kinds of farm machinery. It will be possible to get experience in operating some kinds.
4. Plan a tile drainage system for a particular field, lay out the system, and establish the grade ready for digging the ditch. If time will permit, finish the operation.
5. Observe and criticise numerous farm buildings. Plan a few buildings and estimate amount and cost of material, etc. (Separate problems may be assigned to different students or groups of students.)
6. Plan a system of terracing. Construct and observe the construction of terraces.
7. Repair harness, etc.
8. Practice mixing concrete and making posts, troughs, etc.
9. Practice knots, splices, etc., with rope. (Much of the practice work in mechanics can be done along with the work in farm management.)

II. Practice work in farm management.

(Excellent problems and exercises are given in Boss's Farm Management.)

III. Practice work in improvement of home grounds. (See pages 135-136.)

REFERENCE MATERIAL IN FARM MECHANICS, FARM MANAGEMENT, AND
HOME GROUNDS.

I. Minimum.

1. Bailey: Manual of Gardening (Macmillan Co., Dallas, Texas), \$2.00.
2. Carver: Principles of Rural Economics (Ginn & Co., Dallas, Texas), \$1.30.
3. Davidson: Agricultural Engineering (Webb Pub. Co., St. Paul), \$1.50.
4. Hunt: How to Choose a Farm (Macmillan Co., Dallas, Texas), \$1.75.
5. Roberts: The Farmstead (Macmillan Co., Dallas), \$1.50.
6. Warren: Farm Management (Macmillan Co., Dallas), \$1.75.
7. Waugh: Kemp's Landscape Gardening (John Wiley & Sons, New York), \$1.50.

II. Other books desirable.

1. Allen: Sanitation in the Modern Home (Domestic Engineering, Chicago), \$2.00.
2. Bashore: Sanitation of a Country Home (John Wiley & Sons, New York), \$1.00.
3. Card: Farm Management (Doubleday, Page & Co., Garden City, N. Y.), \$2.00.
4. Davidson & Chase: Farm Machinery and Farm Motors (Orange Judd Co., New York), \$2.00.
5. Ekblaw: Farm Structures (Macmillan Co., Dallas), \$1.75.
6. Elliott: Engineering for Land Drainage (John Wiley & Sons, New York), \$1.50.
7. Elliott: Practical Farm Drainage (John Wiley & Sons, New York), \$1.50.
8. Fairchild: Rural Wealth and Welfare (Macmillan Co., Dallas), \$1.25.
9. French: Farm Drainage (Orange Judd Co., New York), \$1.00.
10. Hays: Farm Development (Orange Judd Co., New York), \$1.50.
11. Hirshfeld & Ulbricht: Farm Gas Engines (John Wiley & Sons, New York), \$1.50.
12. Page: Modern Gasoline Automobile (Henley & Co., New York), \$2.50.
13. Page: Modern Gas Tractor (Henley & Co., New York), \$2.00.
14. Plunkett: The Rural Life Problem of the United States (Macmillan Co., Dallas), \$1.25.
15. Potter: Farm Motors (McGraw-Hill Book Co., New York), \$1.50.
16. Powell: How to Live in the Country (Outing Publishing Co., New York), \$1.75.

17. Powell: Co-operation in Agriculture (Macmillan Co., Dallas), \$1.50.
18. Powell: Country Home (Doubleday, Page & Co., Garden City, N. Y.), \$1.50.
19. Putnam: Gasoline Engine on the Farm (Henley & Co., New York), \$1.50.
20. Reed: Modern House Plans for Everybody (Orange Judd Co., New York), \$1.00.
21. Richards: House Sanitation (Whitcomb & Barrows, Boston), 25c.
22. Richards: The Art of Right Living (Whitcomb & Barrows, Boston), 50c.
23. Roberts: Farmers' Business Hand Book (Macmillan Co., Dallas), \$1.25.
24. Robertson: The Satisfaction of Country Life (Sturgis & Walton, New York), 75c.
25. Taylor: Agricultural Economics (Macmillan Co., Dallas), \$1.25.
26. Stephenson: Farm Engines and How to Run Them (F. J. Drake, Chicago), \$1.00.
27. Streeter: The Fat of the Land (Grosset, New York), 75c.

III. Bulletins and other publications.

1. Bulletin No. 42: Ornamenting Home Grounds (Maine Experiment Station, Orono).
2. Bulletin No. 64: Ornamental Plants for Maine (Maine Experiment Station, Orono).
3. Bulletin No. 55: Ornamental Planting (Nebraska Experiment Station, Lincoln).
4. Bulletin No. 45: Catalog of Ferns and Flowering Plants of Oklahoma (Oklahoma Experiment Station, Stillwater).
5. Bulletin No. 73: Hardy Trees, Shrubs and Vines (Oklahoma Experiment Station, Stillwater).
6. Bulletin No. 12: Residential Sewage Disposal Plants (North Carolina State Board of Health, Raleigh).
7. Bulletin No. 8: Knots, Hitches and Splices (Cornell Reading Course for Farmers, New Series, Ithaca, N. Y.)
8. Bulletin No. 123: Farm Drainage (Utah Experiment Station, Logan).
9. Bulletin No. 8: The Kentucky Sanitary Privy (State Board of Health, Bowling Green).
10. Bulletin No. 136: Rope and Its Uses on the Farm (Minnesota Experiment Station, St. Paul).
11. Bulletin No. 154: Farm Water Supplies of Minnesota (Bureau of Plant Industry, Washington).
12. Bulletin No. 259: What is Farm Management? (Bureau of Plant Industry, Washington).

13. Bulletin No. 262: Ornamental Cacti; Their Culture and Decorative Value (Bureau of Plant Industry, Washington).
14. Bulletin No. 227: Farm Equipment (Ohio Experiment Station, Worcester).
15. Circular No. 7: Labor Saving Devices for the Farm Home (Utah Experiment Station, Logan).
16. Circular No. 138: The Small Home Yard (Illinois Experiment Station, Urbana).
17. Circular No. 22: Improvement of School Grounds (S. C. Experiment Station, Clemson College).
18. Circular 135: How to Fix up the Yard (Illinois Experiment Station, Urbana).

Farmers' Bulletins, U. S. Department of Agriculture, Washington:

19. Bulletin No. 62: Marketing Farm Produce.
20. Bulletin No. 126: Practical Suggestions for Farm Building.
21. Bulletin No. 150: Clearing New Land.
22. Bulletin No. 185: Beautifying the Home Grounds.
23. Bulletin No. 242: Example of Model Farming.
24. Bulletin No. 248: The Lawn.
25. Bulletin No. 270: Modern Conveniences for the Farm Home.
26. Bulletin No. 272: Successful Hog and Seed-Corn Farm.
27. Bulletin No. 277: The Use of Alcohol and Gasoline in Farm Engines.
28. Bulletin No. 280: Profitable Peanut Dairy Farm.
29. Bulletin No. 292: Cost of Filling Silos.
30. Bulletin No. 299: Diversified Farming Under Plantation System.
31. Bulletin No. 303: Corn Harvesting Machinery.
32. Bulletin No. 310: Successful Alabama Diversification Farm.
33. Bulletin No. 311: Land-Clay and Burnt Clay Roads.
34. Bulletin No. 312: Successful Southern Hay Farm.
35. Bulletin No. 321: Use of Split-Log Drag on Earth Roads.
36. Bulletin No. 325: Small Farms in Corn Belt.
37. Bulletin No. 326: Building up a Run-down Cotton Plantation.
38. Bulletin No. 338: Macadam Roads.
39. Bulletin No. 347: Repair of Farm Equipment.
40. Bulletin No. 364: Profitable Cotton Farm.
41. Bulletin No. 365: Farm Management in Northern Potato Growing Sections.
42. Bulletin No. 370: Replanning a Farm for Profit.
43. Bulletin No. 394: Use of Windmills in Irrigation in Semi-arid West.
44. Bulletin No. 403: Construction of Concrete Fence Posts.
45. Bulletin No. 432: How a City Family Managed a Farm.

46. Bulletin No. 438: Hog Houses.
47. Bulletin No. 454: A Successful New York Farm.
48. Bulletin No. 461: Use of Concrete on the Farm.
49. Bulletin No. 463: Sanitary Privy.
50. Bulletin No. 472: System of Farming in Central New Jersey.
51. Bulletin No. 474: Use of Paint on Farm.
52. Bulletin No. 475: Ice Houses.
53. Bulletin No. 481: Concrete Construction on Live Stock Farm.
54. Bulletin No. 511: Farm Bookkeeping.
55. Bulletin No. 519: Example of Intensive Farming in Cotton.
56. Bulletin No. 572: System of Farm Cost Accounting.
57. Bulletin No. 574: Poultry House Construction.

HALF-UNIT IN LANDSCAPE GARDENING.

I. Introduction.

Definition; purpose; esthetic value of beautiful landscape; commercial value of landscape work about the home grounds; need of improvement of home grounds on the farm; effect of home surroundings on keeping the boys and girls on the farm.

II. Choice of homestead.

Accessibility; neighborhood environment; altitude; soil; drainage; sanitation; boundaries; shelter; view; aspect, approaches.

III. General plan of home grounds.

Size; arrangement of yard, garden, barnyard, poultry yard, etc.; location of walks and roads.

IV. Lawn.

1. Grading.

Time; drainage; care to cover surface with surface soil instead of subsoil; use of terraces; undulating surfaces versus level; methods of securing the effect of extent.

2. Preparation of seed bed.

Cultivation; firming; fertilizing.

3. Seeding.

Grasses adapted for lawns; purity and vitality of seeds; methods of seeding and covering; seeding versus sodding.

4. Care of the lawn.

Mowing; fertilizing; watering; mulching in winter.

V. Planting the grounds.

1. What to avoid.

Overplanting; tree belts; over-exposure of grounds; wanton removal of trees; unsuitable ornaments; eccentricities; formality; large geometrical figures; monotony; needless driveways; mixture of styles.

2. Guiding principles.

(1) Simplicity rather than ostentation and extravagance.

(2) Convenience in arrangement and location of greenhouse, flower garden, kitchen garden, etc.

(3) Compactness.

(4) Seclusion and snugness.

(5) Unity: secured in

a. Natural style by: open lawn, curved lines, grouping of trees, use of shrubs, union of buildings with grounds.

b. Architectural style by proper geometrical lines; closely shaven lawns; trees in rows; clipped trees and shrubs, architectural and statuesque features, sharp color contrasts, terraces, flowers in beds or pots, congruous water pieces.

c. Picturesque style by odd plant forms, uneven surface, dark color masses, broken ground, scattering grouping in middle ground.

- (6) Blending.
- (7) Symmetry and gradation.
- (8) Apparent extent.
- (9) Concealment of outbuildings, etc.
- (10) Variety in: surface, form, materials, color, season, composition, position.
- (11) Originality and character.
- (12) Adaptation and fitness.
- (13) Imitation of nature.
- (14) Restful and satisfying effects.

VI. Comparison of effects in different styles.

VII. Some special problems.

1. Mode of access to house.
2. Treatment of walks.
3. Fences.
4. Mounds and banks.
5. Rockeries and fern gardens.
6. Arbors, summer houses, etc.
7. Greenhouses, conservatories, etc.
8. Water and its treatment.
9. Planting designs.
10. Control of insects and diseases.

VIII. Landscape material.

1. Trees adapted to Texas.

(1) Non-coniferous: catalpa (*c. speciosa*), china-berry, elms (cedar, cork, slippery, white) flowering dogwood, hackberry, holly (English and American), huisache (*A. farnesiana*), locust (black), maples (*A. saccharum*, *A. rubrum*), magnolia, mesquite, mulberry, oaks (live-oak, post-oak, red-oak, white-oak), red-bud, sycamore, sweet gum, yaupon, etc.

(2) Coniferous: cedar, cypress, pine (bull, loblolly, yellow).

2. Shrubs adapted to Texas.

Alder, althea, barberries (*B. vulgaris*, *B. Thunbergii*, *B. Japonica*, *B. aquifolium*), crape myrtle, cape jasmine, coral berry (*S. vulgaris*), cats-claw, dogwood, deutzia (*D. gracilis*), euonymus, forsythia, huajillo,

Japanese quince, lantana, lilac, mock orange, privet, roses, spiraeas (*D. Douglasii*, *S. prunifolia*, *S. Thunbergii*, *S. Van Houttei*), sumachs, viburnums (*V. opulus*, *V. lantana*), weigelia, etc.

3. Perennial herbaceous plants.

Anemone, baptisia, bleeding heart, chrysanthemum, columbine, daisies, golden rod, golden glow (*R. laciniata*), hollyhock, Indian blanket, larkspur, peony, phlox, salvia, spring beauty, etc.

4. Annuals: asters, ageratum, alternanthera, alyssum, artillery plant, balsam, bachelor's button, candytuft, cockscomb, calliopsis, cosmos, coleus, castor bean, cigar plant, geranium, heliotrope, nasturtium, pansy, pink, petunia, phlox, stevia, sweet pea, verbena, zinnia, blue bonnet, etc.

5. Climbers.

(1) Perennials: ampelopsis, bittersweet, clematis, grapes, honeysuckle, kudzu vine, madeira, moonseed, roses, smilax, trumpet creeper, wisteria, etc.

(2) Annuals: balloon vine, balsam apple, climbing cucumber, cypress, gourds, hop vine, morning glories, moon flower (*I. Bona-Nox*), nasturtium, sweet pea, etc.

6. Bulbous plants: crocus, dahlia, gladiolus, iris, lily, narcissus, tuberose, tulip, yucca, etc.

IX. General outline for studying landscape material.

1. Adaptation of plant to: soil, moisture, temperature, etc.

2. Study of plant form.

(1) Stem: size, color, form, etc.

(2) Leaves: size, shape, color, texture, etc.

(3) Flowers: size, shape, color, odor, season, use, etc.

(4) Roots: deep or shallow.

(5) Parts of plant valuable for landscape effect.

3. Use of plant: carpet bedding; border plantation, back, front or middle; coarse border or refined planting; specimen; window box; screen; hanging basket, etc.

4. Care of the plant.

Method of propagation; potting, transplanting, etc.; pruning and training; cultivation, fertilizing and watering; care during winter.

(Study material adapted to the community and available for the class. Inquiries concerning ornamentals suited to particular localities will be gladly answered.)

PRACTICE WORK IN LANDSCAPE GARDENING.

1. Observe and study the available material in the community.

2. Study catalogs preparatory to ordering seeds and other material for ornamental planting.

3. Practice operating hotbeds, cold frames, greenhouses, etc.

4. Practice propagating the ornamental material.

5. Order and study the lantern slides to accompany illustrated lecture No. 14, Farm Home Grounds: Their Planting and Care, Office of Experiment Stations, Washington, D. C. (Slides are furnished free except for express charges.)
 6. Take every opportunity to visit and observe any effective landscape work.
 7. Plan designs for ornamenting especially the school grounds and perhaps the home grounds of the students. Work out first the main outline of the design by having students offer designs. Select the best or adapt the best. Assign details of the design to students and groups of students to be worked out. Execute the design agreed upon.
- (The suggestions are meant to be very general. The practice work, however, should be made very important. The students must work with the plants and lay out the designs to get the best out of the course.)

REFERENCE MATERIAL IN LANDSCAPE GARDENING.

I. Minimum.

1. Bailey: Manual of Gardening (Macmillan Co., Dallas, Texas), \$2.00.
2. Henderson: Practical Floriculture (Orange-Judd Co., New York), \$1.50.
3. Rogers: Tree Book (Doubleday, Page & Co., Garden City, N. Y.), \$4.00.
4. Waugh: Kemp's Landscape Gardening (John Wiley & Son, New York), \$1.50.
5. Waugh: Landscape Gardening (Orange-Judd Co., New York), 50c.

II. Other books desirable.

1. Davis: Ornamental Shrubs (G. P. Putnam Sons, New York), \$3.50.
2. Eliot: Landscape Architecture (Houghton, Mifflin Co., Boston), \$3.50.
3. Ely: The Practical Flower Garden (Macmillan Co., Dallas, Texas), \$2.00.
4. Farrer: My Rock Garden (Longmans, Green & Co., New York), \$2.50.
5. Fitzherbert: Book of the Wild Garden (John Lane Co., New York), \$1.00.
6. Greening: Greening Pictorial System of Landscape Gardening (C. E. Greening, Monroe, Mich.), \$5.00.
7. Henderson: Picturesque Gardens and Ornamental Gardening (Henderson & Co., New York), \$2.00.
8. Johnson: Residential Sites and Environments (A. T. De La Mare Ptg. & Publishing Co., New York), \$2.50.

9. Kellaway: *How to Lay Out Suburban Home Grounds* (John Wiley & Sons, New York), \$2.00.
10. Long: *Ornamental Gardening for Americans* (Orange-Judd Co., New York), \$1.50.
11. Maynard: *Landscape Gardening as Applied to Home Decoration* (John Wiley & Sons, New York), \$1.50.
12. Parsons: *Landscape Gardening* (G. P. Putnam's Sons, New York), \$2.00.
13. Parsons: *Landscape Gardening Studies* (John Lane Co., New York), \$2.00.
14. Powell: *Hedges, Windbreaks, Shelters and Live Fences* (Houghton, Mifflin Co., Boston), \$2.00.
15. Sargent: *Manual of the Trees of North America* (Houghton, Mifflin Co., Boston, Mass.), \$6.00.
16. Tabor: *Landscape Gardening Book* (John C. Winston Co., Philadelphia), \$2.00.
17. Thonger: *Book of Garden Design* (John Lane Co., New York), \$1.00.
18. Thonger: *Book of the Cottage Garden* (John Lane Co., New York), \$1.00.
19. Waugh: *Landscape Beautiful* (Orange Judd Co., New York), \$2.00.
20. Webster: *Town Planting* (E. P. Dutton & Co., New York), \$1.75.

III. Bulletins and other publications. (See pages 130-132.)

HALF-UNIT IN ENTOMOLOGY.

I. Introduction.

Relative numbers; statistics on injury to crops and animals; insects as carriers of disease; injury to household and store goods; insects as pollinators; other beneficial insects; useful insect products.

II. Form and physiology of insects.

(Compare grasshopper, butterfly, bug.)

1. Body regions.

- (1) Head: eyes, mouth parts, antennae.
- (2) Prothorax: covering, spiracles.
- (3) Mesothorax: appendages, spiracles, segments.
- (4) Metathorax: appendages, spiracles, segments.
- (5) Abdomen: spiracles, segments, ovipositor, tympanum.

2. Physiology.

- (1) Respiratory system: spiracles, tracheae, air sacs.
- (2) Circulatory system: heart; body cavity; method of circulation.
- (3) Muscular system.
- (4) Digestive system: pharynx, esophagus, crop, gizzard, stomach and caeca, intestine, Malpighian tubes.
- (5) Nervous system: brain, ring commissure, ganglia, nerve cords; sympathetic system.
- (6) Senses of insects: sight, touch, taste, hearing.
- (7) Reproductive system.

III. Growth and transformation of insects.

1. Incomplete metamorphosis: egg, nymph, adult; squash bug, grasshopper, etc.
2. Complete metamorphosis: egg, larva, pupa, adult; butterflies, moths, etc.
3. Development direct: silver fish-moth, etc.

IV. Systematic relationship.

1. Method of classifying animals: phylum, class, order, family, genus, species.
2. Near relation of insects: crustacea, arachnida, myriapoda.

V. Classification of insects.

1. Orthoptera: grasshopper, katydid, praying mantis, walking stick, cockroach, crickets, etc.
2. Hemiptera.
 - (1) Heteroptera: water bugs, leaf bugs, chinch bug.
 - (2) Homoptera: seventeen-year locust, plant lice, scale insects.
 - (3) Parasitica: lice on animals.

3. Coleoptera: tiger beetles, ground beetles, click beetles, fire flies, June beetles, Colorado potato-beetle, long horned beetle, ladybird beetle, cotton boll-weevil, plum curculio, engraver beetle, etc.
4. Lepidoptera.
 - (1) Butterflies: swallowtails, cabbage, monarch, viceroy, etc.
 - (2) Moths: leaf rollers, codling moth, flour moths, peach-tree borer, cutworms, army worms, cecropia, etc.
5. Diptera: mosquitoes, gall gnats, horse flies, bot flies, house flies, fleas, etc.
6. Hymenoptera.
 - (1) Parasitic: ichneumon flies, braconid flies, chalcid flies, etc.
 - (2) Stinging: ants, wasps, bees.

VI. Insect pests of staple crops.

Cotton boll-weevil, cotton boll-worm, chinch bug, grasshopper, cutworms, wire worms, army-worms, "green bugs," cotton louse, Hessian fly, etc.

VII. Insect pests of fruit and truck crops.

Codling moth, borers, San Jose scale, canker worms, plum curculio, peach-tree borer, Colorado potato-beetle, tomato worm, harlequin cabbage bug, melon louse, squash bug, onion thrips, sweet-potato root-borer, etc.

VIII. Insect pests of live stock.

Ox-warble, cattle tick, bot flies, horn flies, lice, mites, etc.

IX. Insect pests of the household.

House fly, mosquito, cockroach, ant, flea, clothes moth, flour moth, flour weevils, etc.

X. Insect pests of shade trees.

Tussock moth, gipsy moth, brown-tailed moth, tent caterpillar, bag worm, etc.

XI. Useful insects.

Honey bees, bumble bees, wasps, dragon flies, lace-wing flies, ladybird beetles, mantids, ichneumon flies, braconid flies, etc.

XII. Control of insects.

1. Natural means.

- (1) Parasites: ichneumon flies, etc.
- (2) Diseases.
- (3) Predacious enemies: birds, toads, frogs, predacious insects.
- (4) Climatic conditions.

2. Artificial means.

- (1) General farming methods: crop rotation, fall plowing, clean culture, etc.
- (2) Cultural methods: timely, proper, fertilizers.
- (3) Spraying.
 - a. Comparison of methods for biting and sucking insects.
 - b. Preparation and use of sprays: Paris green, arsenate of lead, lime-sulfur wash, whale-oil soap solution, kerosene emulsion.
 - c. Spray machinery: hand and power sprayers.
- (4) Fumigation: methods and uses.

XIII. General outline for study of individual insects.

1. Economic importance.
 2. Life history: stages, relative economic importance of different stages, hibernation, method of spread, number of generations.
 3. Food: preferred, acceptable.
 4. Susceptibility to methods of control.
- (Select from the numerous important insects according to time available and local importance.)

PRACTICE WORK IN ENTOMOLOGY.

1. Make trips to field, garden, orchard, roadside, etc., to note habit and food of various insects, and to collect specimens to be preserved for future study and for exhibition.
2. Study carefully the form and physiology of a locust. Make dissections to note the general nature of internal structure. Compare external structure of locusts, butterflies, beetles, and bugs.
3. Try the use of breeding cages to note the stages in life history of mosquitoes, house flies, etc. Collect larvae and cocoons of different insects and note changes. Get eggs of cabbage butterfly and watch development.
4. Procure and preserve all stages of development of as many as possible of insects studied.
5. Prepare and use different sprays.
6. Try hydrocyanic acid gas in fumigating a greenhouse for white fly or a house for insect pests.
7. Try carbon-disulfide in fumigating bins of grain.

REFERENCE MATERIAL IN ENTOMOLOGY.

I. Minimum.

1. Sanderson: *Insect Pests of Farm, Garden and Orchard* (John Wiley & Sons, New York), \$3.00.

II. Other books desirable.

1. Comstock: *Insect Life* (Daniel Appleton & Co., Chicago), \$1.75.
2. Comstock: *Manual for the Study of Insects* (Comstock Publishing Co., Ithaca, New York), \$3.75.
3. Comstock: *Elements of Insect Anatomy* (Comstock Publishing Co., Ithaca, New York), \$1.00.
4. Cragin: *Our Insect Friends and Foes* (G. T. Putnam's Sons, New York), \$1.75.
5. Crittenden: *Insects Injurious to Vegetables* (Orange-Judd Co., New York), \$1.50.
6. Holland: *Collecting and Preserving Insects* (Charles Scribner's Sons, New York), \$2.50.
7. Howard: *Insect Book* (Doubleday, Page & Co., Garden City, New York), \$3.00.
8. Hunter: *Elementary Studies in Insect Life* (Crane & Co., Topeka, Kans.), \$1.25.
9. Kellogg: *American Insects* (Henry Holt & Co., New York), \$4.00.
10. Kellogg: *Insect Stories* (Henry Holt & Co., New York), \$1.50.
11. Kerby: *Elementary Text Book of Entomology* (The Macmillan Co., Dallas), \$3.00.
12. O'Kane: *Injurious Insects* (Macmillan Co., Dallas), \$2.00.
13. Packard: *Entomology for Beginners* (Henry Holt & Co., New York), \$1.50.
14. Packard: *Text Book of Entomology* (Macmillan Co., Dallas, Texas), \$4.50.
15. Sanderson & Jackson: *Elementary Entomology* (Ginn & Co., Dallas), \$2.00.
16. Saunders: *Insects Injurious to Fruits* (J. B. Lippincott Co., Philadelphia), \$2.00.
17. Smith: *Economic Entomology* (J. B. Lippincott Co., Philadelphia), \$2.50.
18. Weed: *Farm Friends and Farm Foes* (D. C. Heath & Co., Chicago), 90c.
19. Weed: *Insects and Insecticides* (Orange-Judd Co., New York), \$1.50.
20. Weed: *Life Histories of American Insects* (Macmillan Co., Dallas, Texas), \$1.50.

III. Bulletins and other publications.

1. Bulletin No. 113: *Spray Calendar* (Texas Experiment Station, College Station, Texas).

2. Bulletin No. 124: Pecan Case Borer (Texas Experiment Station, College Station, Texas).
3. Bulletin, (Press): The Control of Weevils in Corn and Grain (Texas Experiment Station, College Station, Texas).
4. Bulletin, (Press): Treatment of San Jose Scale (Texas Experiment Station, College Station).
5. Bulletin, (Press): Treatment of Melon Louse (Texas Experiment Station, College Texas.)
6. Bulletin No. 24: Texas Beekeeping (Texas Department of Agriculture, Austin).
7. Bulletin No. 6 (New Series): The White Fly (Texas Department of Agriculture, Austin).
8. Bulletin No. 9 (New Series): Control of Insect Pests and Fungus Diseases (Texas Department of Agriculture, Austin).
9. Bulletin No. 37: Use and Value of Wild Birds (Texas Department of Agriculture, Austin).

Bulletins of Bureau of Entomology, Washington, D. C.:

10. Bulletin No. 29. Fall Army Worm and Variegated Cutworm.
11. Bulletin No. 33: Some Insects Injurious to Vegetable Crops.
12. Bulletin No. 55: Rearing of Queen Bees.
13. Bulletin No. 62: San Jose or Chinese Scale.
14. Bulletin No. 72: Information Concerning North American Fever Tick.
15. Bulletin No. 73: Studies of Parasites of Cotton Boll-Weevil.
16. Bulletin No. 74: Some Factors in Natural Control of Mexican Cotton Boll-Weevil.
17. Bulletin No. 77: Hibernation of Mexican Cotton Boll-Weevil.
18. Bulletin No. 85: Papers on Cereal and Forage Insects.
19. Bulletin No. 88: Preventive and Remedial Work Against Mosquitoes.
20. Bulletin No. 100: Insect Enemies of Cotton Boll-Weevil.
21. Bulletin No. 103: Plum Curculio.
22. Bulletin No. 114: Report on Mexican Cotton Boll-Weevil.
23. Bulletin No. 119: Dispersion of Gipsy Moth.
24. Bulletin No. 121: Behavior of Honey Bee in Pollen Collecting.

Circulars, Bureau of Entomology, Washington, D. C.:

25. Circular No. 99: Nut weevils.
26. Circular No. 103: Harlequin Cabbage Bug.
27. Circular No. 108: House Fleas.
28. Circular No. 113: Chinch Bug.

29. Circular No. 116: Large Corn Stalk-borer.
30. Circular No. 120: Control of Brown-rot and Plum Curculio on Peaches.
31. Circular No. 131: How to Control Pear Thrips.
32. Circular No. 137: Alfalfa Weevil.
33. Circular No. 139: Damage to Sugar Cane in Louisiana by Sugar-Cane Borer.
34. Circular No. 149: Cotton Stainer.
35. Circular No. 153: Cotton Worm of Cotton Caterpillar.
36. Circular No. 162: Potato-Tuber Moth.

Farmers' Bulletins, Washington, D. C.:

37. Bulletin No. 54: Some Common Birds in Their Relation to Agriculture.
38. Bulletin No. 99: Three Insect Enemies of Shade Trees.
39. Bulletin No. 127: Important Insecticides, Directions for Their Preparation and Use.
40. Bulletin No. 132: Principal Insect Enemies of Growing Wheat.
41. Bulletin No. 155: How Insects Affect Health in Rural Districts.
42. Bulletin No. 172: Scale Insects and Mites on Citrus Trees.
43. Bulletin No. 209: Controlling Boll-Weevil in Cotton Seed and at Ginneries.
43. Bulletin No. 211: Use of Paris Green in Controlling Boll-Weevil.
44. Bulletin No. 223: Miscellaneous Cotton Insects in Texas.
45. Bulletin No. 231: Spraying for Cucumber and Melon Diseases.
46. Bulletin No. 243: Fungicides and Their Use in Preventing Diseases of Fruits.
47. Bulletin No. 264: Brown Tail Moth and How to Control It.
48. Bulletin No. 283: Spraying for Apple Diseases and Codling Moths in the Ozarks.
49. Bulletin No. 284: Insect and Fungus Enemies of Grapes East of Rocky Mountains.
50. Bulletin No. 290: Cotton Boll Worm, Summary of Its Life History and Habits.
51. Bulletin No. 378: Methods of Exterminating Texas Fever Ticks.
52. Bulletin No. 440: Spraying Peaches for Control of Brown-Rot, Scab and Curculio.
53. Bulletin No. 442: Treatment of Bee Diseases.
54. Bulletin No. 444: Remedies and Preventives Against Mosquitoes.
55. Bulletin No. 447: Bees.
56. Bulletin No. 453: Danger of General Spread of Gipsy

and Brown Tail Moths Through Imported Nursery Stock.

57. Bulletin No. 459: House Flies.
58. Bulletin No. 478: How to Prevent Typhoid Fever.
59. Bulletin No. 492: More Important Insect and Fungous Enemies of Fruit and Foliage of Apple.
60. Bulletin No. 498: Methods of Exterminating Texas Fever Tick.
61. Bulletin No. 500: Control of Boll-Weevil.
62. Bulletin No. 506: Food of Some Well Known Birds of Forest, Farm and Garden.
63. Bulletin No. 513: Fifty Common Birds of Farm and Orchard.

WEEDS.

Some place in the agricultural course in the high school there should come a rather definite study of the weeds of the community, and the ways to control them. A very convenient place for the study is at the beginning of the work in botany. A time should be selected when weeds in all stages of growth are available in the community. The following outline is intended to suggest some work that will be valuable.

- I. Weeds in general: definition, importance of weed control; prevalence of weeds in community; list of weeds familiar to students.
- II. Classification of weeds as to life cycle: annuals; winter annuals; biennials; perennials.
- III. Methods of reproduction of weeds: seeds; roots; runners; underground rootstocks and seeds; underground rootstocks, running stems, and seeds.
- IV. Habits of growth.
 1. Habit of growth of part above ground.
Erect, decumbent, creeping, stemless, twining, or climbing.
 2. Habits of growth of root system.
Deep-rooted, shallow-rooted, lateral spread, etc.
- V. Methods of seed dissemination.
 1. Natural agencies.
 - a. Wind: dandelions, sunflowers, tumble weeds, witch grass, thistles, milk weeds, etc.
 - b. Water: effect of early spring rains, streams, etc.
 - c. Explosive force of seed pods: wild geranium, wild pea, sorrel, etc.
 - d. Seeds that have creeping qualities: wild oats.
 2. Artificial means of distribution.
 - a. Animals.
 - (1) Carried on wool of sheep.
 - (2) Stick to hoofs and hair of other animals.
 - (3) Carried in the digestive tract of animals.
 - b. Birds.
 - (1) Cling to feathers.
 - (2) Sticky seeds, as from mistletoe, stick to bill and feet.
 - (3) Carried in digestive tract.
 - c. Human agencies.
 - (1) Stick to shoes and clothing.
 - (2) Some plants distributed for ornamental and economic purposes become weeds.
 - (3) Moving wagons and tools on the farm.
 - (4) Vehicles on public roads.

- (5) Community threshing machines.
- (6) Distributed in manure.
- (7) Feeding screenings.
- (8) Railroads as public carriers.
- (9) Sowing impure agricultural seeds.

VI. Ways in which weeds cause harm.

1. Lower crop yield.
 - a. Use large amounts of soil moisture.
 - b. Use plant food.
 - c. Shade and crowd plants.
 - d. Feed on other plants (parasites).
2. Immense amount of labor required to control.
3. Poisonous weeds injure live stock.
4. Some weed seeds become matted in wool of sheep and materially lower its value.
5. Lower crop values by
 - a. Presence of weed seed in threshed grain.
 - b. Presence of weeds in forage crops.
6. Injure pastures.
7. Injure the quality and reduce the value of dairy products.
8. Act as harbors for insect pests.
9. Serve as hosts for fungous diseases.
10. Lower land value.

VII. Make a list of weeds most troublesome in:

Gardens, lawns, pastures, meadows, grain fields, cotton fields, etc.

VIII. Methods of eradicating weeds.

1. Annuals: prevent seeding by mowing, pulling, clean culture, spraying, etc.
2. Biennials. (See methods for eradicating annuals).
3. Perennials.
 - a. Clean cultivation.
 - b. Summer fallowing.
 - c. Smothering with thick, dense growing crop.
 - d. Spraying for some perennials.
 - e. Methods of eradicating small areas or isolated plants.

IX. Sprays and spraying.

1. Kind and size of spray machines used.
2. Spray mixtures to use for best results.
3. Time to spray.
4. Number of applications necessary.
5. Kind of crops that can be sprayed without injury.
6. List of annuals, biennials, perennials killed by spraying.

X. Outline for study of each weed.

1. Name of plant.
2. Native or introduced.
3. Where commonly found growing.

4. Annual, biennial, perennial.
5. Habit of growth.
6. Method of reproduction.
7. Methods of dissemination.
8. Noxious characteristics.
9. Brief description of the plant.
 - a. Flowers: simple or composite, color, size, shape, number and arrangement of petals and sepals.
 - b. Leaves: netted vein, parallel vein, size, shape, color, condition, and arrangement.
 - c. Stem: shape, structure, size, length, habit of growth, and condition.
 - d. Roots: kind, habit of growth, depth and spread.
 - e. Seeds.
 - (1) Size, color, shape and condition of seed coat.
 - (2) Number of seeds produced by most common annuals, biennials, and perennials.
 - (3) Vitality of different weed seeds under ordinary conditions.
 - (4) Vitality of buried seed.
 - (5) Influence of vitality on methods of eradication.
10. Best method of eradication.

XI. Birds as a factor in helping to control weeds.

XII. Seed inspection and weed laws.

1. Seed importation act of August 24, 1912.
2. Study of two or three of the best State laws.

PRACTICE WORK IN WEEDS.

1. Study twenty-five of the most common weeds found on the farms and in the gardens in the community. The weeds should be dug up, so as to retain as much of the root system as possible and taken to the laboratory for study.
2. Write a complete description of each weed, following the outline for study of each weed.
3. Make a number of excursions into the fields and identify the different weeds found growing there. Have students carry note book and pencil and write down the name of each weed identified.
4. Have students collect samples of seed from twenty-five of the most common weeds found on the excursions. The samples may be collected in envelopes, paper bags, or sometimes carried to the school building on the weed. Thresh the sample, clean it, and put it in a screw-top vial and label it.
5. Supply the students with cardboard holders for seed. These holders may be made by taking a piece of bristol cardboard about twelve inches long and two inches wide,

punching twelve $\frac{3}{4}$ -inch holes in it, and pasting it on solid piece of cardboard of the same size. Place a sample of weed seed in each hole and have the students identify them.

6. Place samples of agricultural seeds such as alfalfa, clovers, timothy seed, etc., before the class and have them make a purity test of the sample identifying as many of the foreign seeds as possible.
7. Estimate the number of seeds borne on one plant of some of the most common weeds.
8. A single plant of lamb's quarters has been known to bear 608,300 seed. If a single plant of this weed should grow and mature this number of seed, and each of these in turn should grow and produce an equal number of seed, how many plants would there be the second year? How many plants per acre for a one-hundred-sixty-acre farm? How many plants per square foot for the same farm?
9. A single plant of tumble weed has been known to produce 11,057,859 seeds. If each one of these should grow and produce the same number of seeds and continue to reproduce in the same way, in how many years would there be produced a plant for each acre of land in the world?

REFERENCE MATERIAL IN WEEDS.

I. Some desirable books.

1. Bell: Weeds and Wild Flowers (Richard G. Badger, Boston), \$1.25.
2. Long & Percival: Common Weeds of the Farm and Garden (F. A. Stokes Co., New York), \$2.00.
3. Pammel: Talk on Weeds (L. H. Pammel, Ames, Iowa), \$1.50.
4. Pammel: Weeds of the Farm and Garden (Orange-Judd Co., New York), \$1.50.
5. Shaw: Weeds and How to Eradicate Them (Webb Pub. Co., St. Paul), 50c.

II. Bulletins and other publications.

1. Bulletin No. 175: Ohio Weed Manual (Ohio Experiment Station, Wooster).
2. Bulletin No. 260: Seeds of Michigan Weeds (Michigan Experiment Station, E. Lansing).
3. Bulletin No. 105: Eradication of Weeds (Iowa Experiment Station, Ames).
4. Bulletin No. 257: Weed Factor in Cultivation of Corn (Bureau of Plant Industry, Washington).

Farmers' Bulletins, Department of Agriculture, Washington, D. C.

5. Bulletin No. 188: Weeds Used in Medicine.
6. Bulletin No. 260: Seed of Red Clover and Its Impurities.

7. Bulletin No. 306: Dodder in Relation to Farm Seeds.
8. Bulletin No. 368: Eradication of Bindweed, or Morning-Glory.
9. Bulletin No. 380: Loco-Weed Disease.
10. Bulletin No. 382: Adulteration of Forage Plant Seeds.
11. Bulletin No. 468: Eradication of Quack-Grass.
12. Bulletin No. 531: Larkspur, or Poison Weed.

MINIMUM LABORATORY AND GARDEN EQUIPMENT FOR TWELVE STUDENTS.

BOTANY.

Quantity and Material.	Approximate List Price.
3 Compound Microscopes	\$85.00
1 Section Razor85
6 Dozen Glass Slides.....	.50
$\frac{1}{2}$ Dozen Cover Glasses.....	.45
6 Dissecting Scissors	1.50
6 Dissecting Forceps65
12 Tripod Lenses	4.50

PLANT PROPOGATION AND VEGETABLE GARDENING.

12 Garden Hoes	6.00
12 Garden Rakes	6.00
6 Spading Forks	4.50
12 Garden Trowels	1.80
25 6-inch Flower Pots	1.10
200 2-inch Flower Pots90
275 3-inch Flower Pots	2.00

SOIL.

2 Ring Stands, No. 2, 3 rings.....	3.60
2 Burette Clamps60
2 Mohr's Burettes, 50 c.c., for use with pinch cock.....	2.00
6 Dozen 8x1 inch Test Tubes.....	2.50
12 Test Tube Brushes70
12 Nests Beakers, No. 0, No. 1, No. 2.....	3.75
1 Iron Mortar and Pestle, 2 pints.....	.65
4 Porcelain Mortar and Pestle, 4-inch.....	1.75
24 Porcelain Evaporating Dishes, 3-inch.....	3.00
3 Dozen Stirring Rods, 8-inch.....	1.00
6 4-inch Funnels (Glass)95
12 Packages Filter Paper, 10 c. m.....	1.40
6 Crucible Tongs, Steel, 9-inch	1.25
24 Crucibles, Porcelain, No. 00.....	3.60
3 Volume Weight Tubes of brass, 12x2 inch.....	3.00
9 Brass Tubes for water holding capacity of soils, 12x2 inch..	9.00
6 Glass Tubes, 1-inch by 5 feet.....	3.30
1 Agate Bearing Trip Scale	6.65
1 Set of Weights, 1 kilo to 5 grams.....	2.40
1 Single Well Drying Oven, 6x6x8 inch.....	5.00
1 Set Soil Sieves, wooden frame, brass gauge, 6-inch diameter, 20, 40, 60, 80, 100 mesh round holes.....	2.50
1 Kerosene or Gasoline Burner.....	10.00
6 Alcohol Lamps, 8 ounces.....	2.40

Quantity and Material.	Approximate List Price.
3 Dessicators, Schreiber's 6-inch diameter.....	3.60
1 250 c.c. Cylinder, Graduated.....	.80
2 100 c.c. Cylinder, Graduated.....	1.00
2 Thermometers, 10-210 degrees centigrade.....	1.60
1 Pound Glass Tubing, 3-16 inch diameter.....	.40
1 Dozen quart Mason Jars.....	.75
1 Dozen half-gallon Mason Jars.....	1.00
10 Feet Rubber Tubing, 3-16 inch diameter.....	.70
2 Mohn's Pinchcocks, medium size.....	.25
1 Soil Auger, 2 inches diameter, 40 inches long.....	2.50
1 Specific Gravity Tube, iron, 3 inches diameter.....	2.00

ANIMAL HUSBANDRY.

1 Babcock Milk tester, 8 bottles, iron case, with 8 milk test bottles, pipette, acid measure, pint bottle of acid.....	10.00
12 Milk Test Bottles, 10 per cent, graduated to $\frac{1}{8}$ per cent.....	2.00
12 Cream Test Bottles, 30 per cent, graduated to $\frac{1}{2}$ per cent....	2.60
12 Skim Milk Bottles, graduated to 1-100 per cent.....	4.80
12 Pipettes, 17.6 cc.....	1.80
2 Acid Measures, 17.5 cc.....	.35
1 Brass Dividers, 4 $\frac{1}{2}$ -inch.....	.25
1 Dozen Cleaning Brushes for Bottles.....	.55
1 Lactometer50
1 Barrel Churn, 10-gallon.....	3.50
1 Cream Separator	65.00
1 Incubator	15.00

OTHER EQUIPMENT.

1 Barrel Spray Outfit.....	15.00
1 Pruning Shears, Wiss' Solid Steel.....	2.25
1 English Lopping Shears.....	3.00
1 Pruning Saw75
1 Farm Level, Rod and Plumb Bob.....	15.00
1 100-foot Linen Tape.....	1.35
1 Saw and Pruner Combined.....	1.50

APPENDIX.

SCORE CARD FOR COTTON.

(Texas A. and M. College.)

SCALE OF POINTS.

	Perfect Score.	Student's Score.	Corrected Score.
Form , indicating fruitfulness; (short jointed, well branched).....	15		
Yield (standard, 1 bale or more per acre):			
(a) Size of bolls (standard, 40 bolls per pound when open, or 2-in. in diameter when fully mature but not open; 1 point off for each additional 5 bolls, or each eighth of an inch off in size).....	15		
(b) Percentage of lint (standard, 40 per cent or above): short staple, 1 point cut for 1 per cent off; long staple, 1-2 point cut for 1 per cent off	10		
(c) Number mature bolls per plant: standard, unfavorable conditions 20; standard, medium conditions 60; standard, favorable conditions 100.....	15		
Earliness (standard, earliest plants of King).....	10		
Hardiness of plants toward disease.....	3		
Storm Resistance	2		
Opening and ease of picking.....	2		
LINT:			
Length of lint (upland, etc., 7-8 to 1 1-4 inches; long staple, 1 1-2 to 2 inches).....	8		
Uniformity of length.....	8		
Strength.....	3		
Fineness.....	3		
Color.....	2		
Maturity.....	2		
Uniformity of Seed	2		
Total	100		

SCORE CARD FOR CORN.

(Texas A. and M. College.)

SCALE OF POINTS.		Perfect Score.	Student's Score.	Corrected Score.
GENERAL APPEARANCES—PRODUCTIVENESS:		25		
1. Size of ear.....		10		
2. Shape of ear.....		8		
3. Filling of butts.....		5		
4. Filling of tips.....		2		
TRUENESS TO TYPE:		25		
5. Shape and size of ear.....		10		
6. Shape and size of kernel.....		8		
7. Purity of color of cob and grains.....		5		
8. Straightness and arrangement of rows.....		2		
MATURITY AND MARKET CONDITION:		20		
9. Solidity of ears.....		8		
10. Plumpness of kernels.....		6		
11. Adherence of tip-cap to cob.....		2		
12. Adherence of chaff to tip-cap.....		1		
13. Size of ear and cob.....		2		
14. Color and finish of kernels.....		1		
VITALITY:		20		
16. Damage by weevils.....		5		
17. Color of embryo.....		3		
18. Size of embryo.....		2		
19. Size of germ.....		3		
20. Adherence of tip-cap to cob.....		2		
21. Adherence of chaff to tip-cap.....		1		
22. Condition of cob.....		2		
23. Plumpness of tips of kernels.....		2		
SHELLING PERCENTAGE:		10		
24. Depth of kernels.....		4		
25. Size and density of cob.....		3		
26. Space at cob.....		1		
27. Furrows between rows.....		1		
28. Filling of butts and tips.....		1		
Total number of points scored by each ear.....		100		

SCORE CARD FOR WHEAT.

(Texas A. and M. College.)

SCALE OF POINTS.		Perfect Score.	Student's Score.	Corrected Score.
1.	Weight per bushel.....	20		
2.	Soundness.....	20		
3.	Purity.....	15		
4.	Size and plumpness of kernels.....	15		
5.	Uniformity in—			
	(a) Hardness.....	15		
	(b) Color.....	10		
	(c) Size of kernels.....	5		
Total.....		100		

SCORE CARD FOR OATS.

(Texas A. and M. College.)

SCALE OF POINTS.		Perfect Score.	Student's Score.	Corrected Score.
1.	Uniformity of grades.....	10		
2.	Color.....	10		
3.	Size and plumpness.....	15		
4.	Per cent hull.....	15		
5.	Per cent foreign matter.....	15		
6.	Per cent damaged grain.....	15		
7.	Weight per bushel.....	20		
Total.....		100		

SCORE CARD FOR DRAFT HORSES.

(Texas A. and M. College.)

SCALE OF POINTS—FOR GELDING.		Perfect Score.	Student's Score.	Corrected Score.
1. Age.....(estimate by teeth).....				
GENERAL APPEARANCE:				
2. Height.....				
3. Weight, over 1500 lbs.score according to age.....		4		
4. Form, broad, massive, low set, proportioned.....		4		
5. Quality, bone clean, yet indicating sufficient substance; tendons distinct; skin and hair fine.....		4		
6. Temperament, energetic, good disposition.....		4		
HEAD AND NECK:				
7. Head, lean, medium size.....		1		
8. Muzzle, fine; nostrils large; lips thin, even.....		1		
9. Eyes, full, bright, clear, large.....		1		
10. Forehead, broad, full.....		1		
11. Ears, medium size, well carried.....		1		
12. Neck, muscled; crest high; throatlatch fine; windpipe large.....		1		
FOREQUARTERS:				
13. Shoulders, sloping, smooth, snug, extending into back.....		2		
14. Arm, short, thrown forward.....		1		
15. Forearm, heavily muscled, long, wide.....		2		
16. Knees, wide, clean cut, straight, deep, strongly supported.....		2		
17. Cannons, short, lean, wide; tendons large, set back.....		2		
18. Fetlocks, wide, straight, strong.....		1		
19. Pasterns, sloping, lengthy, strong.....		3		
20. Feet, large, even size, straight; horn dense; dark color; sole concave; bars strong; frog large, elastic; heel wide, high, one-half length of toe.....		8		
21. Legs, view in front, a perpendicular line from the point of the shoulder should fall upon the center of the knee, cannon, pastern and foot. From the side, a perpendicular line dropping from the center of the elbow joint should fall upon the center of the knee and pastern joints and back of hoof.....		4		
BODY:				
22. Chest, deep, wide, low, large girth.....		2		
23. Ribs, long, close, well sprung.....		2		
24. Back, straight, short, broad.....		2		
25. Loin, wide, short, thick, straight.....		2		
26. Underline, flank low.....		1		
HINDQUARTERS:				
27. Hips, smooth, wide.....		2		
28. Croup, long, wide, muscular.....		2		
29. Tail, attached high, well carried.....		1		
30. Thighs, muscular.....		2		
31. Quarters, deep, heavily muscled.....		2		
32. Gaskins or Lower Thighs, wide, muscled.....		2		
33. Hocks, clean cut, wide, straight.....		8		
34. Cannons, short, wide; tendons large, set back.....		2		
35. Fetlocks, wide, straight, strong.....		1		
36. Pasterns, sloping, strong, lengthy.....		2		
37. Feet, large, even size; straight; horn dense, dark color; sole concave; bars strong, frog large, elastic; heel wide, high, one-half length of toe.....		6		
38. Legs, viewed from behind, a perpendicular line from the point of the buttock should fall upon the center of the hock, cannon, pastern and foot. From the side, a perpendicular line from the hip joint should fall upon the center of the foot and divide the gaskin in the middle; and a perpendicular line from the point of the buttock should run parallel with the line of the cannon.....		4		
ACTION:				
39. Walk, smooth, quick, long, balanced.....		6		
40. Trot, rapid, straight, regular.....		4		
Total.....		100		

SCORE CARD FOR LIGHT HORSES.

(Texas A. and M. College.)

SCALE OF POINTS—FOR GELDING.		Perfect Score.	Student's Score.	Corrected Score.
1. Age.....(estimate by teeth).....				
GENERAL APPEARANCE:				
2. Weight.....				
3. Height.....				
4. Form, symmetrical, smooth, stylish.....		4		
5. Quality, bone clean, fine, and yet indicating sufficient substance; tendons defined; hair and skin fine.....		4		
6. Temperament, active, good disposition.....		4		
HEAD AND NECK:				
7. Head, lean, straight.....		1		
8. Muzzle, fine; nostrils large; lips thin, even.....		1		
9. Eyes, full, bright, clear, large.....		1		
10. Forehead, broad, full.....		1		
11. Ears, medium size, pointed, well carried, and not far apart.....		1		
12. Neck, muscled; crest high; throatlatch fine; windpipe large.....		1		
FOREQUARTERS:				
13. Shoulders, long, smooth with muscle, oblique, extending into back and muscled at withers.....		3		
14. Arm, short, thrown forward.....		1		
15. Forearm, muscled, long, wide.....		2		
16. Knees, clean, wide, straight, deep, strongly supported.....		2		
17. Cannons, short, wide; tendons large, set back.....		2		
18. Fetlocks, wide, straight.....		1		
19. Pasterns, strong, angle with ground 45 degrees.....		3		
20. Feet, medium, even size, straight; horn dense; frog large, elastic; bars strong; sole concave; heel wide, high.....		6		
21. Legs, viewed in front, a perpendicular line from the point of the shoulder should fall upon the center of the knee, cannon, pastern and foot. From the side, a perpendicular line dropping from the center of the elbow joint should fall upon the center of the knee and pastern joints and back of hoof.....		4		
BODY:				
22. Chest, deep, low; large girth.....		2		
23. Ribs, long, sprung, close.....		2		
24. Back, straight, short, broad, muscled.....		2		
25. Loin, wide, short, thick.....		2		
26. Underline, long, flank let down.....		1		
HINDQUARTERS:				
27. Hips, smooth, wide, level.....		2		
28. Croup, long, wide, muscular.....		2		
29. Tail, attached high, well carried.....		1		
30. Thighs, long, muscular, spread, open angled.....		2		
31. Quarters, heavily muscled, deep.....		2		
32. Gaskins or Lower Thighs, long, wide, muscular.....		2		
33. Hocks, clearly defined, wide, straight.....		5		
34. Cannons, short, wide; tendons large, set back.....		2		
35. Fetlocks, wide, straight.....		1		
36. Pasterns, strong, sloping.....		2		
37. Feet, medium, even size, straight; horn dense; frog large, elastic; bars strong; sole concave; heel wide, high.....		4		
38. Legs, viewed from behind, a perpendicular line from the point of the buttock should fall upon the center of the hock, cannon, pastern and foot. From the side, a perpendicular line from the hip joint should fall upon the center of the foot and divide the gaskin in the middle; and a perpendicular line from the point of the buttock should run parallel with the line of the cannon.....		4		
ACTION:				
39. Walk, elastic, quick, balanced.....		5		
40. Trot, rapid, straight, regular, high.....		15		
Total.....		100		

SCORE CARD FOR DRAFT MULES.

(Texas A. and M. College.)

SCALE OF POINTS.		Perfect Score.	Student's Score.	Corrected Score.
Age—(Estimate by teeth).....				
GENERAL APPEARANCE—27 Points.				
Height, 16 hands or over; estimated.....actual.....		4		
Weight, 1200 to 1600 lbs. in good condition; estimated.....lbs. score according to age.....		5		
Form, broad, massive, symmetrical, blocky.....		4		
Quality, bone clean, large, strong; tendons clean, defined; skin and hair fine.....		4		
Action, walk straight, stride long, fast, elastic, regular.....		5		
Trot, rapid, straight, regular, balanced.....		3		
Temperament, energetic; disposition, good.....		2		
HEAD AND NECK—9 Points.				
Head, proportionate size, clean cut, well carried; profile straight.....		1		
Muzzle, fine; nostrils large, flexible; lips thin, even, firm.....		1		
Eyes, full, bright, clear, same color.....		1		
Forehead, broad, full.....		1		
Ears, large, fine texture, well carried, tapering.....		2		
Lower Jaw, angles wide, space clean.....		1		
Neck, well muscled, arched; throatlatch fine; windpipe large.....		2		
FOREQUARTERS—23 Points.				
Shoulder, long, sloping, well muscled, extending into back.....		2		
Arm, short, heavily muscled, thrown back, well set.....		1		
Forearm, heavily muscled, long, wide.....		2		
Knees, wide, clean cut, deep, straight, strongly supported.....		2		
Cannons, short, wide, clean; tendons large, clean, defined, set back.....		2		
Fetlocks, wide, straight, strong, clean.....		1		
Pasterns, moderate length, strong, clean, sloping at an angle of 45 degrees with ground.....		3		
Feet, large, even, sound; horn dense, waxy; soles concave; bars strong; frog large, elastic; heels wide and high.....		6		
Legs, viewed in front, a perpendicular line from the point of the shoulder should fall upon the center of the knee, cannon, pastern and foot; from the side, a perpendicular line dropping from the center of the elbow joint should fall upon the center of the knee and pastern joints and back of hoof.....		4		
BODY—9 Points.				
Chest, deep, wide; breast bone low; girth, large.....		2		
Ribs, deep, well sprung, close.....		2		
Back, broad, short, strong, muscular.....		2		
Loin, short, wide, heavily muscled.....		2		
Underline, long, flank low.....		1		
HINDQUARTERS—30 Points.				
Hips, smooth, wide, level.....		2		
Croup, long, wide, muscular, not too drooping.....		2		
Tail, attached high, well carried.....		1		
Thighs, deep, broad, strong, well muscled.....		2		
Quarters, deep, heavily muscled.....		2		
Gaskins, (lower thighs) long, wide, clean, well muscled.....		2		
Hocks, large, strong, wide, deep, clean.....		7		
Cannons, short, wide, clean; tendons large, clean, defined, set back.....		2		
Fetlocks, wide, straight, strong, clean.....		1		
Pasterns, moderately long and sloping, strong and clean.....		2		
Feet, large, even size, sound; horn dense, waxy; sole concave; bars, strong; frog, large, elastic; heels wide and high.....		5		
Legs, viewed from behind, a perpendicular line from the point of the but- tock should fall upon the center of the hock, cannon and foot; from the side, a perpendicular line from the hip joint should fall upon the center of the foot and divide the gaskin in the middle; and a perpen- dicular line from the point of the buttock should run parallel with the line of the cannon.....		4		
Total.....		100		

SCORE CARD FOR BEEF CATTLE.

(Texas A. and M. College.)

SCALE OF POINTS—FOR STEER.		Perfect Score.	Student's Score.	Corrected Score.
GENERAL APPEARANCE:				
1.	Weight, score according to age.....	10		
2.	Form, straight topline and underline; deep, broad, low set, stylish.....	10		
3.	Quality, hair fine, skin pliable; dense, clean bone; body covering to be uniform, of a mellow touch, yet sufficiently firm to indicate a large proportion of muscle.....	10		
4.	Condition, development of flesh and fat; fat indicated by spinal covering, rib covering, fullness of flank, purse and tongue root.....	10		
HEAD AND NECK:				
5.	Muzzle, broad; mouth large; jaw wide; nostrils large.....	1		
6.	Eyes, large, clear, placid.....	1		
7.	Face, short, quiet expression.....	1		
8.	Forehead, broad, full.....	1		
9.	Ears, medium size, fine texture.....	1		
10.	Horns, fine texture, oval, medium size.....	1		
11.	Neck, thick, short, throat clean.....	1		
FOREQUARTERS:				
12.	Shoulder Vein, full.....	2		
13.	Shoulder, covered with flesh, compact on top, smooth.....	2		
14.	Brisket, advanced, breast wide.....	1		
15.	Dewlap, skin not too loose and drooping.....	1		
16.	Legs, straight, short; arm full; shank fine, smooth.....	2		
BODY:				
17.	Chest, full, deep, wide; girth large; crops full.....	4		
18.	Ribs, long, arched, thickly fleshed.....	8		
19.	Back, broad, straight, smooth, even.....	10		
20.	Loin, thick, broad.....	8		
21.	Flank, full, even with underline.....	2		
HINDQUARTERS:				
22.	Hips, smoothly covered, distance apart in proportion with other parts.....	2		
23.	Rump, long, wide, even, tail head smooth, not patchy.....	2		
24.	Pin Bones, not prominent, far apart.....	1		
25.	Thighs, full, deep, wide.....	2		
26.	Twist, deep, plump.....	2		
27.	Purse, full, indicating fleshiness.....	2		
28.	Legs, straight, short; shank fine, smooth.....	2		
Total.....		100		

SCORE CARD FOR MUTTON SHEEP.

(Texas A. and M. College.)

SCALE OF POINTS—FOR WETHER.

	Perfect Score.	Student's Score.	Corrected Score.
1. Age.....(estimate by teeth).....			
GENERAL APPEARANCE:			
2. Weight.....(score according to age).....	8		
3. Form, long, level, deep, broad, low set, stylish.....	10		
4. Quality, clean bone; silky hair, fine skin, light in offal, yielding large percentage of meat.....	10		
5. Condition, deep, even coloring of firm flesh, especially in region of valuable cuts. Points indicating condition of ripeness are thick dock, back thickly covered with flesh, thick neck, full purse, full flank, plump breast.....	10		
HEAD AND NECK:			
6. Muzzle, fine; mouth large; lips thin; nostrils large.....	1		
7. Eyes, large, clear, placid.....	1		
8. Face, short, clean cut features.....	1		
9. Forehead, broad, full.....	1		
10. Ears, fine, erect.....	1		
11. Neck, thick, short, throat free from folds.....	1		
FOREQUARTERS:			
12. Shoulder Vein, full.....	1		
13. Shoulder, covered with flesh, compact on top, smooth.....	1		
14. Brisket, projecting forward, breast wide.....	1		
15. Legs, straight, short, wide apart, strong; forearm full; shank smooth and fine.....	1		
BODY:			
16. Chest, wide; deep, full, indicating constitution.....	8		
17. Back, broad, straight, long, thickly fleshed; ribs arched.....	10		
18. Loin, thick, broad, long.....	10		
HINDQUARTERS:			
19. Hips, far apart, level, smooth.....	2		
20. Rump, long, level, wide to tail head.....	3		
21. Thighs, full, deep, wide.....	3		
22. Twist, plump, deep.....	3		
23. Legs, straight, short, strong; shank smooth, fine.....	1		
WOOL:			
24. Kind, domestic, territory, carpet or blanket.....			
25. Class, clothing, delaine or combing.....			
26. Grade, fine, medium or coarse.....			
27. Quality, long, dense, even.....	4		
28. Quality, fine, pure; crimp close, regular, even.....	4		
29. Condition, bright; sound, clean, soft, light.....	4		
Total.....	100		

SCORE CARD FOR FINE WOOL SHEEP.

(Texas A. and M. College.)

SCALE OF POINTS.

	Perfect Score.	Student's Score.	Corrected Score.
1. Age.....(estimate by teeth).....			
GENERAL APPEARANCE:			
2. Weight.....			
3. Form, level, deep, stylish, round rather than square.....	8		
4. Quality, lean, fine bone; silky hair; fine skin.....	6		
HEAD AND NECK:			
5. Muzzle, fine, broad, wrinkly nose; pure white.....	1		
6. Eyes, large, clear, placid.....	1		
7. Face, wrinkly, covered with soft velvety coat.....	1		
8. Forehead, broad, full.....	1		
9. Ears, soft, thick, velvety.....	1		
10. Neck, short, muscular, well set on shoulders.....	1		
FOREQUARTERS:			
11. Shoulders, strong, being deep and broad.....	4		
12. Brisket, projecting forward; breast wide.....	1		
13. Legs, straight; short; wide apart; shank smooth and fine.....	2		
BODY:			
14. Chest, deep, full, indicating constitution.....	10		
15. Back, level, long; round ribbed.....	4		
16. Loin, wide, level.....	4		
17. Flank, low, making underline straight.....	2		
HINDQUARTERS:			
18. Hips, far apart, level, smooth.....	2		
19. Rump, long, level, wide.....	4		
20. Legs, straight, short, strong; shank smooth, fine.....	2		
WOOL:			
21. Kind, domestic, clean and bright.....			
Carpet			
Blanket			
Territory			
} Hairy or having dead fibre.....			
22. Class, clothing, fibre under two inches in length or unsound.....			
Delaine, fiber two or three inches in length.....			
Combing, fiber over three inches in length and sound.....			
23. Grade, fine, medium or coarse.....			
24. Quantity, long, dense, even covering, especially over crown, cheek, armpit, hind leg and belly.....	15		
25. Quality, fine fiber, crimp close; regular, even quality, including tops of folds.....	15		
26. Condition, bright, lustrous, sound, pure, soft, even distribution of yolk, with even surface to fleece.....	15		
Total.....	100		

SCORE CARD FOR DAIRY CATTLE.

(Texas A. and M. College.)

SCALE OF POINTS—FOR COW.

	Perfect Score.	Student's Score.	Corrected Score.
GENERAL APPEARANCE:			
1. Form , inclined to be wedge-shaped.....	6		
2. Quality , hair fine, soft; skin mellow, loose, medium thickness, secretion yellow; bone, clean, fine.....	6		
3. Temperament , lean, though vigorous appearance, when in milk.....	6		
HEAD AND NECK:			
4. Muzzle , clean cut; mouth large; nostrils large.....	1		
5. Eyes , large, bright, full, mild.....	1		
6. Face , lean, long, quiet expression.....	1		
7. Forehead , broad.....	1		
8. Ears , medium size, yellow inside, fine texture.....	1		
9. Horns , fine texture, waxy.....	1		
10. Neck , fine, medium length; throat clean, light dewlap.....	1		
FOREQUARTERS:			
11. Withers , lean, thin.....	1		
12. Shoulders , light, oblique.....	2		
13. Legs , straight, short, shank fine.....	2		
BODY:			
14. Chest , deep, low; girth large with full fore flank.....	10		
15. Barrel , ribs broad, long, wide apart, large stomach.....	10		
16. Back , lean, straight, open jointed.....	2		
17. Loin , broad.....	2		
18. Navel , large.....	2		
HINDQUARTERS:			
19. Hips , far apart, level.....	2		
20. Rump , long, wide.....	2		
21. Pin Bones or Thurls , high, wide apart.....	1		
22. Tail , long, slim, fine hair in switch.....	1		
23. Thighs , thin, long.....	4		
24. Escutcheon , spreading over thighs, extending high and wide; large thigh ovals.....	2		
25. Udder , long, attached high and full behind, extending far in front and full, flexible; quarters even and free from fleshiness.....	20		
26. Teats , large, evenly placed.....	5		
27. Mammary Veins , large, long, tortuous, branched with double extension; large and numerous milk wells.....	5		
28. Legs , straight, short; shank fine.....	2		
Total.....	100		

SCORE CARD FOR LARD HOGS.

(Texas A. and M. College.)

SCALE OF POINTS—FOR BARROW.

	Perfect Score.	Student's Score.	Corrected Score.
GENERAL APPEARANCE:			
1. Weight, score according to age.....	6		
2. Form, deep, broad, low, symmetrical, compact, standing squarely on legs.....	10		
3. Quality, hair silky; skin fine; bone fine; mellow covering of flesh, free from lumps and wrinkles.....	10		
4. Condition, deep, even covering of flesh and fat over all parts of the body.....	10		
HEAD AND NECK:			
5. Snout, medium length, not coarse.....	1		
6. Eyes, full, mild, bright.....	1		
7. Face, short, cheeks full.....	1		
8. Ears, fine, medium size, soft.....	1		
9. Jawl, strong, neat, broad.....	1		
10. Neck, thick, medium length.....	1		
FOREQUARTERS:			
11. Shoulder, broad, deep, full, compact on top.....	6		
12. Legs, straight, short, strong; bone clean, pasterns upright; feet medium size.....	2		
BODY:			
13. Chest, deep, broad, large girth.....	4		
14. Sides, deep, lengthy, full; ribs close and well sprung.....	6		
15. Back, broad, straight, thickly and evenly fleshed.....	10		
16. Loin, wide, thick, straight.....	8		
17. Belly, straight, even.....	4		
HINDQUARTERS:			
18. Hips, wide apart, smooth.....	2		
19. Rump, long, wide, evenly fleshed, straight.....	2		
20. Ham, heavily fleshed, plump, full, deep, wide.....	10		
21. Thighs, fleshed close to hocks.....	2		
22. Legs, straight, short, strong; bone clean; pasterns upright; feet medium size.....	2		
Total.....	100		

SCORE CARD FOR BACON HOGS.

(Texas A. and M. College.)

SCALE OF POINTS—FOR BARROW.		Perfect Score.	Student's Score.	Corrected Score.
GENERAL APPEARANCE:				
1. Weight , 170 to 200 pounds, the result of thick cover of firm flesh.....		6		
2. Form , long, level, smooth, deep.....		10		
3. Quality , hair fine; skin thin; bone fine; firm covering of flesh without any soft bunches of fat or wrinkles.....		10		
4. Condition , deep uniform covering of flesh, especially in region of valuable cuts.....		10		
HEAD AND NECK:				
5. Snout , fine.....		1		
6. Eyes , full, mild, bright.....		1		
7. Face , slim.....		1		
8. Ears , trim, medium size.....		1		
9. Jowl , light, trim.....		1		
10. Neck , medium length, light.....		1		
FOREQUARTERS:				
11. Shoulders , free from roughness, smooth, compact and same width as back and hindquarters.....		6		
12. Breast , moderately wide, full.....		2		
13. Legs , straight, short, strong; bone clean, pasterns upright; feet medium size.....		2		
BODY:				
14. Chest , deep, full girth.....		4		
15. Back , medium and uniform in width.....		8		
16. Sides , long, smooth, level from beginning of shoulders to end of hindquarters. The side at all points should touch a straight edge running from fore to hindquarter.....		10		
17. Ribs , deep, uniformly sprung.....		2		
18. Belly , trim, firm, thick, without any flabbiness or shrinkage at flank....		10		
HINDQUARTERS:				
19. Hips , smooth, wide; proportionate to rest of body.....		2		
20. Rump , long, even, straight, rounded toward tail.....		2		
21. Gammon , firm, rounded, tapering, fleshed deep and low toward hocks.....		8		
22. Legs , straight, short, strong; feet medium size; bone clean; pasterns upright.....		2		
Total		100		

SCORE CARD FOR DAIRIES.

(Adopted by the Official Dairy Instructors' Association.)

EQUIPMENT	SCORE		METHODS	SCORE	
	Perfect	Allowed		Perfect	Allowed
COWS			COWS		
Health.....	6		Cleanliness of cows.....	8	
Apparently in good health.....1			STABLES		
If tested with tuberculin			Cleanliness of stables.....	6	
once a year and no tuber-			Floor.....2		
culosis is found, or if test-			Walls.....1		
ed once in six months and			Ceiling and ledges.....1		
all reacting animals remov-			Mangers and partitions.....1		
ed.....5			Windows.....1		
(If tested only once a year and			Stable air at milking time.....	6	
reacting animals found and re-			Barnyard clean and well drained	2	
moved, 2)			Removal of manure daily to field		
Comfort.....	2		or proper pit.....	2	
Bedding.....1			(to be 50 feet from stable, 1.)		
Temperature of stable.....1			MILK ROOM		
Food (clean and wholesome).....	2		Cleaning of milk room.....	3	
Water.....	2		UTENSILS AND MILKING		
Clean and fresh.....1			Care and cleanliness of utensils...	8	
Convenient and abundant.....1			Thoroughly washed and		
STABLES			sterilized in live steam for		
Location of stable.....	2		30 minutes.....5		
Well drained.....1			(Thoroughly washed and		
Free from contaminating			placed over steam jet, 4; thor-		
surroundings.....1			oughly washed and scalded with		
Construction of stable.....	4		boiling water, 3; thoroughly		
Tight, sound floor and prop-			washed, not scalded, 2.)		
er gutter.....2			Inverted in pure air.....3		
Smooth, tight walls and			Cleanliness of milking.....	9	
ceiling.....1			Clean, dry hands.....3		
Proper stall, tie and manger....1			Udders washed and dried.....6		
Light: Four sq. ft. of glass			(Udders cleaned with moist		
per cow.....	4		cloth, 4; cleaned with dry cloth,		
(Three sq. ft., 3; 2 sq. ft., 2; 1			at least 15 minutes before milk-		
sq. ft., 1. Deduct for uneven			ing, 1.)		
distribution.)			HANDLING THE MILK		
Ventilation: Automatic system			Cleanliness of attendants.....	1	
Adjustable windows.....1			Milk removed immediately from		
Cubic feet of space for cow:			stable.....	2	
500 to 1,000 feet.....	3		Prompt cooling (cooled imme-		
(Less than 500 ft., 2; less than			diately after milking each cow)		
400 ft., 1; less than 300 ft., 0;			Efficient cooling; below 50° F....	2	
over 1,000 feet, 0.			(51° to 55°, 5; 56° to 60°, 2.)	5	
UTENSILS			Storage, below 50° F.....	3	
Construction and condition of			(51° to 55°, 2; 55° to 60°, 1.)		
utensils.....	1		Transportation, iced in summer	3	
Water for cleaning.....	1		(For jacket or wet blanket,		
(Clean, convenient, abundant)			allow 2, dry blanket or covered		
Small-top milking pail.....	3		wagon, 1.)		
Facilities for hot water or steam					
(Should be in milk house, not	1				
in kitchen.)					
Milk cooler.....	1				
Clean milking suits.....	1				
MILK ROOM					
Location of milk room.....	2				
Free from contaminating sur-					
roundings.....	2				
Convenient.....	1				
Construction of milk room.....					
Floors, walls and ceiling.....1					
Light, ventilation, screens.....1					
Total.....	40		Total.....	60	

Equipment..... + Methods..... = Final Score.

NOTE 1.—If any filthy condition is found, particularly dirty utensils, the total score shall be limited to 49.

NOTE 2.—If the water is exposed to dangerous contamination or there is evidence of a dangerous disease in animals or attendants, the score shall be 0.

SCORE CARD FOR BUTTER.

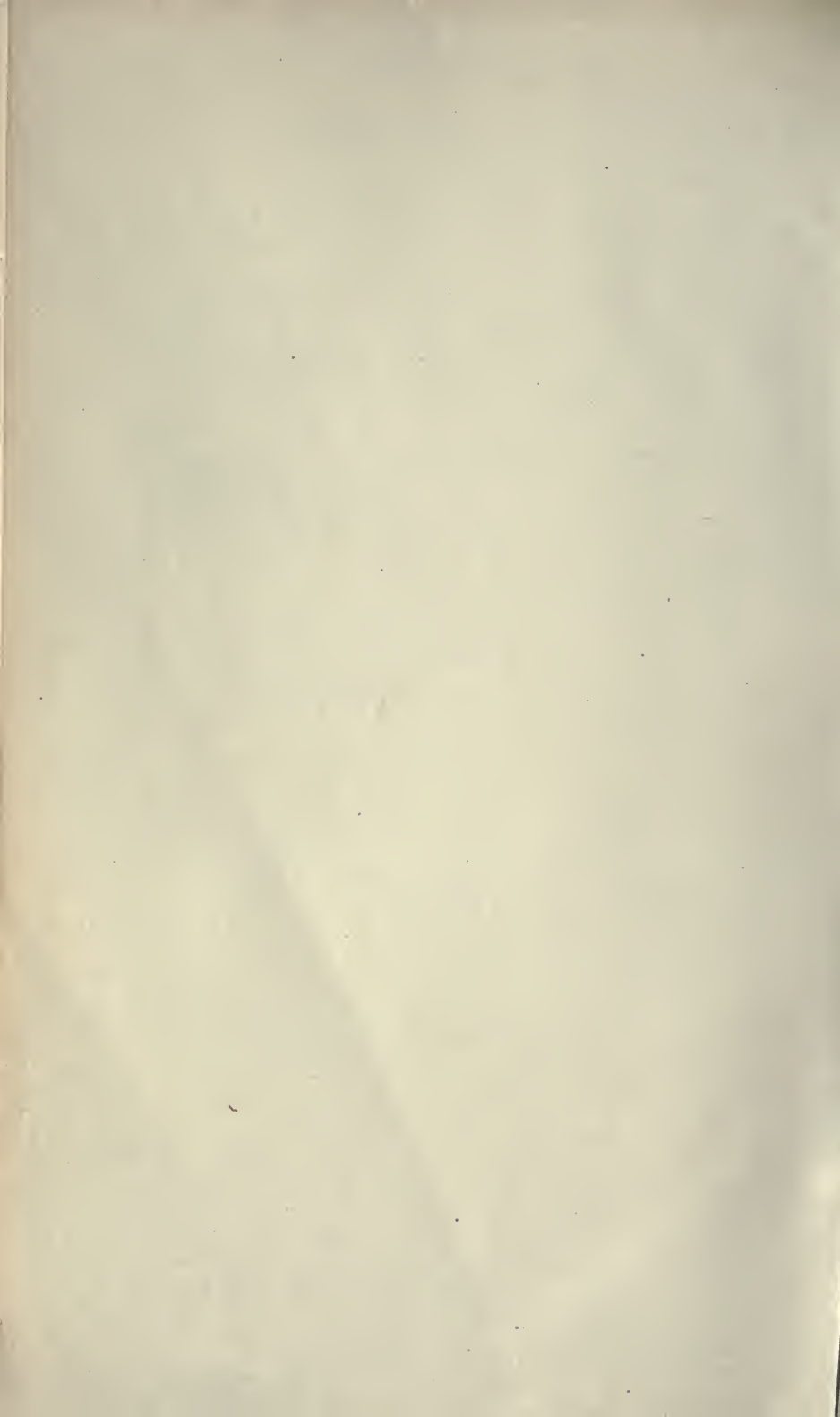
SCALE OF POINTS.	Perfect Score.	Student's Score.	Corrected Score.
Flavor , (defects: curdy, light, rancid, fishy, feverish, oily or greasy, weedy, stable, unclean, high acid, bitter).....	45		
Texture , (defects: poor grain, cloudy brine, weak body, too much brine, greasy).....	25		
Color , (defects: mottles, white specks, too high, too light, color specks).....	15		
Salt , (defects: too much salt, undissolved, poor salt, lacks salt).....	10		
Package , (defects: dirty, poorly packed, poorly nailed).....	5		
Total.....	100		

SCORE CARD FOR FARMS.
(Warren's Farm Management.)

SCALE OF POINTS.	Names of Farms.		
SIZE: 1. Adapted to kind of farming.....			
FIELDS: 2. Shape and size..... 3. Nearness to farmstead.....			
TOPOGRAPHY: 4. As affecting ease of cultivation..... 5. As affecting production..... 6. As affecting erosion and loss of fertility..... 7. As affecting air drainage.....			
FERTILITY: 8. Natural..... 9. Condition.....			
PHYSICAL PROPERTIES OF THE SOIL: 10. As affecting economy of cultivation..... 11. As affecting number of days of labor..... 12. As affecting loss of soil fertility..... 13. As affecting kinds of possible crops.....			
DRAINAGE: 14. Natural..... 15. Artificial.....			
CONDITION: 16. Freedom from stumps, stones, weeds, waste land, etc.....			
CLIMATE: 17. As affecting animal and crop production..... 18. As affecting number of days of labor.....			
HEALTHFULNESS: 19. As an economic factor.....			
LOCATION: 20. Distance to market..... 21. Roadways..... 22. Local markets..... 23. Shipping facilities..... 24. Neighbors as an economic factor..... 25. Labor supply of neighborhood..... 26. R. F. D., telephone, trolleys, etc..... 27. Churches, school, grange, etc., as economic factors.....			
TAXES: 28. Per cent on cash value.....			
WATER SUPPLY: 29. Running water, wells.....			
IMPROVEMENTS: 30. Site of farmstead..... 31. House as adapted to needs of farm..... 32. Other buildings..... 33. Fences: kind, condition, arrangement..... 34. Timber, orchards, vineyards, etc.....			
INVESTMENT: 35. Probability of an increase in value.....			
ACREAGE: 36. Total acres..... 37. Acres tillable..... 38. Acres pasture not tillable..... 39. Acres woods..... 40. Acres roads, waste, etc.....			
ESTIMATED TOTAL VALUE OF: 41. Tillable area..... 42. Pasture..... 43. Woods..... 44. Barns..... 45. Houses.....			
Total.....			

Price asked.

(Use words excellent, very good, good, fair, poor, or very poor in marking points of farm. Use score card to prevent forgetting any important point.)



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